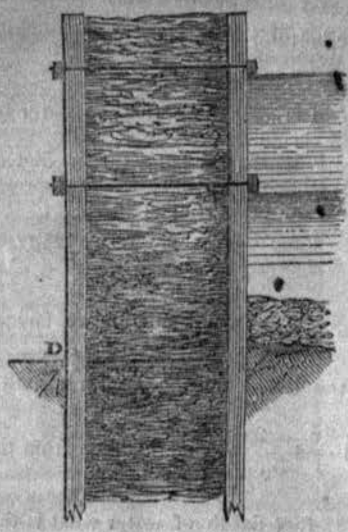
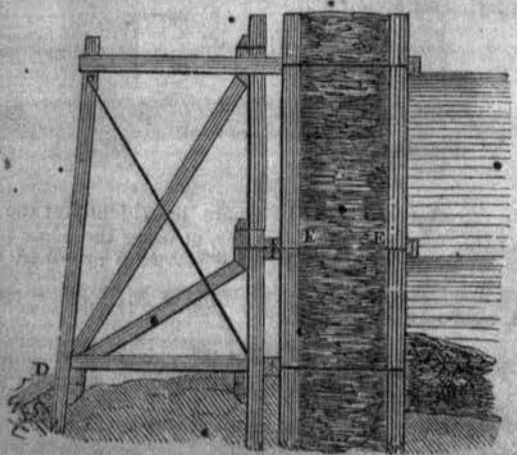
Fig. 2.



Put s for the mean weight in lbs. of a cubic foot of the materials in the dam, b for its height in feet, d for its width in feet, and c for the depth of high water in feet. We then have $b\,d\,s$ equal the weight of one foot in lenght. It is evident that the dam fails only when the force of the water is able to turn it round the point D, and as the weight $b\,d\,s$ acts at the distance $\frac{d}{2}$ from D in the figure its force is properly represented by $b\,d\,s\times\frac{d}{2}=\frac{b\,d^2s}{2}$. The pressure of the water is equal $\frac{125c^2}{2}$ (problem 1,) which acting at the distance $\frac{c}{3}$ above D (problem 3) has its force represented by $\frac{125c^2}{2}\times\frac{c}{3}=\frac{125c^3}{6}$. Therefore in case of equilibrium we have $\frac{b\,d^2s}{2}=\frac{125c^3}{6}$. from which equation we find $d^2=\frac{125c^3}{3\,b\,s}$ and $d=\sqrt{\frac{125c^3}{3\,b\,s}}$. From this proposition it is clear that when $b=c$, *the width d of the dam is proportional to the depth of the water, and that the power of water to overturn a dam is as the cube of its depth.* The value of s will depend on the nature of the puddle used in the dam, and the proportion it bears to the quantity of timber and iron in the width d. In the examples to this and the following problems, s is supposed to be equal to 90 lbs., which in most cases may not be far from the true value, except in those cases where the water penetrates under the dam when it must be reduced to about one-third, or to 30 lbs. nearly.

Fig. 3.



Example 1.—Find the width of a coffer-dam sufficient to resist the pressure of 17 feet of water on the outside, the height of the dam being 19 feet.

Here we have

$$d=\sqrt{\frac{125c^3}{3\,b\,s}}=\sqrt{\frac{125\times17^3}{3\times19\times90}}=\sqrt{\frac{614125}{5130}}=\sqrt{116\cdot4}=10\cdot8 \text{ feet.}$$

If $b=c=17$ feet, then $d=17\sqrt{\frac{125}{270}}=11\cdot6$ feet. If we suppose from want of proper precaution the water to penetrate under the dam, s is reduced to about $\frac{s}{3}$ for the height c, say $\frac{s}{n}$, we then get

$(b-c)\,ds+cd\times\frac{s}{n}\times\frac{d}{2}=\frac{125c^3}{6}$ for the equation of equilibrium from which we find $d^2\times(3\,nbs+3cs-3\,ncs)=125c^3n$ and

$d=\sqrt{\frac{125nc^2}{3nbs+3\,cs-3\,ncs}}$. When $n=3$ as would be nearly the case in practice, $d=\sqrt{\frac{125c^3}{s\times(3b-2c)}}$. By using the numbers in example 1, we get by this formulæ

$d=\sqrt{\frac{125\times17^3}{90\times(57-34)}}=\sqrt{\frac{614125}{2070}}=\sqrt{296\cdot7}=17\cdot2$ feet, shewing under these circumstances a necessary increase of nearly six feet in width.

Example 2.—What width of dam is sufficient to resist the pressure of 17 feet depth of water, the dam to rise 4 feet above the surface, when the bottom is porous gravel communicating with the water.

In this case we have

$$d=\sqrt{\frac{125c^3}{90(3\,b-2\,c)}}=\sqrt{\frac{125\times17^3}{90\times(63-34)}}=\sqrt{\frac{614125}{90\times29}}=\sqrt{\frac{614125}{2610}}=\sqrt{235\cdot3}=15\cdot3 \text{ feet.}$$

PROBLEM VII.

To find the strength of a coffer-dam (fig. 3) sufficient to resist the pressure of a given depth of water so that by the intervention of stays, &c. the coffer-dam could only fail by the failure of the point D.

Put k for the distance E D, d for the distance E F, and by using the same notation as before for the other dimensions, we get by the properties of the lever $bds\times(\frac{d}{2}+k)=\frac{125c^2}{2}\times\frac{c}{3}$ for the equation of equilibrium, and by reduction $d^2+2\,kd=\frac{125c^3}{3\,bs}$ from which we find

$$d=\sqrt{\frac{125c^3}{3\,bs}+k^2}-k.$$

Example 1.—Find the width d when $k=18$, $c=17$, and $b=21$ feet, here $\sqrt{\frac{125c^3}{3\,bs}+k^2}-k=\sqrt{\frac{125\times17^3}{3\times21\times90}+18^2}-18=\sqrt{\frac{614125}{5670}+32\cdot4}-18=\sqrt{649}-18=25\cdot5-18=7\cdot5$ feet$=d$. These were nearly the dimensions of the coffer-dam for building the river wall at the New Houses of Parliament (see Journal, vol. I, page 31). But this coffer-dam was still held more firmly on its base by the resistance to the piles penetrating the silth and clay substratum requiring a considerable force to overcome it, over and above that which was already sufficiently resisted by the upper portion of the coffer-dam.

When d is given we find from the equation $d^2+2\,dk=\frac{125c^3}{3\,bs}$,

$$k=\frac{125c^3}{6\,bsd}-\frac{d}{2}.$$

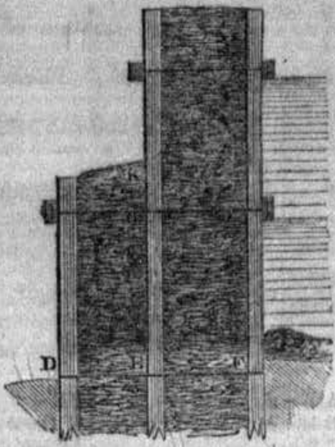
Example 2.—At what distance from the inner sheet pileing of a coffer-dam 10 feet wide shall we place the brace pileing D, so that when properly braced the dam shall resist the pressure of 30 feet depth of water outside. The dam rising 4 feet above the surface.

Here $k=\frac{125\times30^3}{6\times34\times90\times10}-\frac{10}{2}=\frac{3375000}{18360}-5=18\cdot4-5=13\cdot4$ feet the distance required. If $s=30$ as would be nearly the case if the bottom was porous, k should be increased to about $3\times 18{\cdot}4-5=55.2-5=50$ feet. This shows the importance of securing the bed of the dam from water by dredging, or otherwise clearing away all porous materials.

PROBLEM VIII.

To find the strength of a dam (form fig. 4) sufficient to resist the pressure of a given depth of water.

Fig. 4.



By using the same notation as before, putting f for E K, and k for D E, we get $sbd\times(\frac{d}{2}+k)+skf\times\frac{k}{2}=\frac{125c^2}{2}\times\frac{c}{3}$ for the equation of equilibrium from which $sbd^2+2sbdk+sfk^2=\frac{125c^3}{3}$. This equation gives us $d^2+2dk=\frac{125c^3}{3bs}-\frac{k^2f}{b}$ and $k^2+\frac{2bd}{f}k=\frac{125c^3}{3sf}-\frac{bd^2}{f}$. From these we find $d=\sqrt{\frac{125c^3}{3bs}+\frac{(b-f)k^2}{b}}-k$ (1), and

$$k=\sqrt{\frac{125c^3}{3sf}-\frac{bd^2}{f}+\frac{b^2d^2}{f^2}}-\frac{bd}{b}. \quad (2).$$

From these values for d and k we can find one when the other is given.

Example 1.—Having given $k=4$ feet, $f=10$ feet, $b=21$ feet, and $c=17$ feet, to find the value of d?

By equation (1) $d=\sqrt{\frac{125c^3}{3bs}+\frac{(b-f)k^2}{b}}-k=\sqrt{\frac{614125}{5670}+\frac{176}{21}}-4=\sqrt{108{\cdot}3+8{\cdot}4}-4=\sqrt{116{\cdot}7}-4=10{\cdot}8-4=6{\cdot}8$, or 7 feet nearly, the value required.

Example 2.—Suppose $k=10$ feet, $f=17$ feet, $b=33$ feet, and $c=30$ feet, what is the width (d) equal to?

Here $d=\sqrt{\frac{125\times 30^3}{3\times 33\times 90}+\frac{16\times 10}{33}}-10=\sqrt{\frac{12500}{33}+\frac{1600}{33}}-10=\sqrt{\frac{14100}{33}}-10=\sqrt{427{\cdot}3}-10=20{\cdot}7-10=10{\cdot}7$ feet, the width required.

Example 3.—To find the value of k when $d=6$ feet, the other dimensions remaining the same as in Example 1.

From equation (2) $k=\sqrt{\frac{125c^3}{3sf}-\frac{bd^2}{f}+\frac{b^2d^2}{f^2}}-\frac{bd}{f}=\sqrt{\frac{614125}{2700}-\frac{756}{10}+\frac{15876}{100}}-\frac{126}{10}=\sqrt{227{\cdot}5-75{\cdot}6+158{\cdot}8}-12{\cdot}6=\sqrt{310{\cdot}7}-12{\cdot}6=17{\cdot}6-12{\cdot}6=5$ feet, the value sought.

Example 4.—To find the value of k when $d=10$ feet, the other dimensions remaining the same as in Example 2?

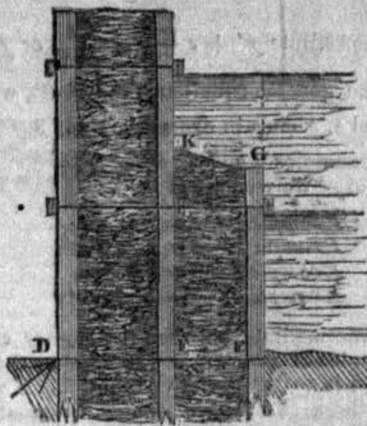
Here $k=\sqrt{\frac{125\times 30^3}{3\times 90\times 17}-\frac{33\times 10^2}{17}+\frac{33^2 10^2}{17^2}}-\frac{33\times 10}{17}=$

$\sqrt{\frac{12500-3300}{17}+\frac{108900}{289}}-\frac{330}{17}=\sqrt{541{\cdot}2+376{\cdot}8}-19{\cdot}4=\sqrt{918}-19{\cdot}4=30{\cdot}3-19{\cdot}4=10{\cdot}9$ feet, the value sought.

PROBLEM IX.

To find the strength of a coffer-dam fig. 5, sufficient to resist the pressure of a given depth of water.

Fig. 5.



Here, by putting k' for F E, and f' for K F, we have

$$\left(\frac{k'}{2}+d\right)\times sk'f'+\frac{d}{2}\times sdb=\frac{125c^2}{2}\times\frac{c}{3},$$

for the equation of equilibrium by disregarding the vertical pressure of the water above K G, and thence $sk'^2f'+2sdk'f'+d^2sb=\frac{125c^3}{3}$; from this equation we get

$$d^2+\frac{2k'f}{b}d=\frac{125c^3}{3bs}-\frac{k'^2f'}{b}$$

and $k'^2+2dk'=\frac{125c^3}{3sf'}-\frac{d^2b}{f'}$; these equations give

$$d=\sqrt{\frac{125c^3}{3sb}-\frac{k'^2f'}{b}+\frac{k'^2f'^2}{b^2}}-\frac{k'f'}{b} \qquad (1).$$

$$\text{and } k'=\sqrt{\frac{125c^3}{3sf'}-\frac{bd^2}{f'}+d^2}-d \qquad (2).$$

Example 1.—When k' is equal 4 feet, what is the value of d, the other dimensions being the same as those in example 1, problem 8.

From equation (1) $d=\sqrt{\frac{125\times 17^3}{3\times 90\times 21}-\frac{4^2\times 10}{21}+\frac{10^2\times 4^2}{21^2}}$

$$-\frac{10\times 4}{21}=\sqrt{\frac{614{,}125}{5670}-\frac{160}{21}+\frac{1600}{441}}-\frac{40}{21}$$

$$=\sqrt{108{\cdot}3-7{\cdot}6+3{\cdot}6}-1{\cdot}9-\sqrt{104{\cdot}3}-1{\cdot}9$$

$=10{\cdot}2-1{\cdot}9=8{\cdot}3$ feet.

Example 2.—Using the same dimensions as in example 2, problem 8, what is the value of d?

$$d=\sqrt{\frac{125\times 30^3}{3\times 33\times 90}-\frac{10^2\times 17}{33}+\frac{10^2\times 17^2}{33^2}}-\frac{10\times 17}{33}.$$

$$=\sqrt{\frac{12{,}500-1700}{33}+\frac{28{,}900}{1089}}-5{\cdot}2=$$

$\sqrt{327{\cdot}3+26{\cdot}5}-5{\cdot}2-\sqrt{353{\cdot}8}-5{\cdot}2=18{\cdot}9-5{\cdot}2=13{\cdot}7$ feet.

Example 3.—Using the same dimensions as those in example 3, problem 8, what is the value of k?

From equation (2) $k=\sqrt{\frac{125\times 17^3}{3\times 90\times 10}-\frac{21\times 6^2}{10}+6^2}-6$

$=\sqrt{227{\cdot}5-75{\cdot}6+36}-6=\sqrt{187{\cdot}9}-6=13{\cdot}7-6=7{\cdot}7$ feet.

Example 4.—Using the same dimensions as those for example 4, problem 8, what is the value of k'?

$$k'=\sqrt{\frac{125\times 30^3}{3\times 90\times 17}-\frac{10^2\times 33}{17}+10^2}-10$$

$$=\sqrt{\frac{12{,}500-3300}{17}+100}-10=\sqrt{\frac{9200}{17}+100}-10$$

$$=\sqrt{541\cdot2+100}-10=25\cdot3-10=15\cdot3 \text{ feet.}$$

If we take into consideration the weight of the water above K G, the values found for d and k in the examples are too high; but the gravity of the materials in the dam being to the gravity of the water as s to $62\frac{1}{2}$, if we substitute $f'+\overline{c-f}\times\frac{2s}{125}$, or $f'+\overline{c-f'}\times\frac{2}{3}$ (nearly), for f' in the general equations (1) and (2), we will find correct values for d and k. Thus in examples 1 and 3, $f'=10+\overline{17-10}\times\frac{2}{3}=\frac{44}{3}$, and in examples 2 and 4, $f'=17+\overline{30-17}\times\frac{2}{3}=\frac{77}{3}$; using these values of f' we would find in

Example 1.—$d=7\cdot4$ feet;
Example 2.—$d=11\cdot2$ feet;
Example 3.—$k=5\cdot9$ feet;
Example 4.—$k=11\cdot4$ feet;

all of which are intermediate between the former values and those found in the examples of problem 8. It appears therefore in these examples that fig. 4 is to be prefered to fig. 5. If we wish to have equal strength in these two forms, we get by equating the general equations in problems 8 and 9, $s\,b\,d^2+2\,s\,b\,d\,k+s\,k^2f=s\,k'^2f'+2\,s\,d\,k'f'+d^2s\,b$, and thence $2\,b\,d\,k+k^2f=k'^2f'+2\,d\,k'f'$, which equation will furnish the value of any of the quantities when the others are given. By substituting $f'+\frac{2c-2f'}{3}=\frac{2c+f'}{3}$ for f', we take into consideration the weight of water over K G; in assisting the stability of the dam Fig. 5, this substitution gives us $6\,b\,d\,k+3\,k^2f=2\,c\,k'^2+4\,c\,d\,k'+(k'^2+2\,d\,k')f'$, for a general equation of equal strength in both forms.

The subject we have now been considering, is closely connected with the consideration of the comparative strength of buttresses and contreforts to retaining walls. If we put n for the weight of a cubic foot of earthwork or filling, and s for that of masonry, and substitute $f'\times\frac{\overline{c-f'}\times n}{s}$ for f' in the equation $2\,bdk+k^2f=2\,dk'f'+k'^2f'$, we get $2\,bdsk'+k^2fs=(k'^2+2\,dk')\times\frac{nc+(s-n)f'}{s}$ for a general equation of equal stability between buttress and contrefort, by which we may with ease determine any of the dimensions by having the others given, as none of the quantities rise higher than the second power. The quantity $\frac{\overline{c-f'}\times n}{s}$ is the height of a prism of masonry equal in weight to a prism of clay whose height is $c-f$. This prism acts with the clay or filling in moving out the wall, and also, from its weight on the contrefort, gives the latter greater stability. This double action often separates the contrefort from the main wall when both are not well bonded into each other.

Having pointed out the method of taking the weight over K G, Fig. 5 into account, where considered necessary, we will neglect it in the examples to the following problem, though the formulæ are general by substituting $\frac{2c+f'}{3}$ for f'.

Problem X.

To find the dimensions of a coffer-dam, Fig. 6, sufficient to resist the pressure of a given depth of water.

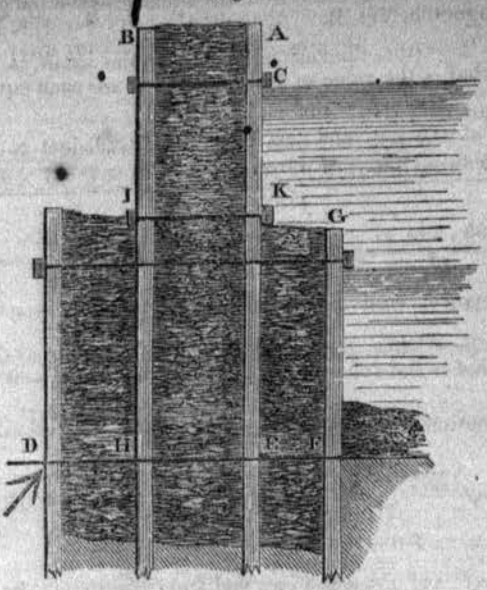
By observing the same notation as in the former problems, we get from the principles of the lever,

$$sf'k'+(k+d+\frac{k'}{2})+s\,b\,d\times(k+\frac{d}{2})+s\,f\,k\times\frac{k}{2}=\frac{125c^2}{2}\times\frac{c}{3}$$

for the equation of equilibrium, and by reduction we find $2\,k\,k'f'+2\,k'f'\,d+k'^2f'+2\,k\,d\,b+b\,d^2+f\,k^2=\frac{125\,c^3}{3\,s}=m\,c^3$ by putting $m=\frac{125}{3\,s}$. From this equation we find

$$d^2+\frac{2\,k'f'+2\,k\,b}{b}\times d=\frac{mc^3-2\,k\,k'f'-k'^2f'-k^2f}{b};$$

Fig. 6.



A B $=d$
B H $=b$
C E $=c$
I H $=f'$
H D $=k$
FE $=k'$
K E $=f$.

$$k^2+\frac{2\,b\,d+2\,k'f'}{f}\,k=\frac{m\,c^3-2f'\,d\,k'-f'\,k'^2-b\,d^2}{f};$$

$$\text{and } k'^2+(2\,d+2\,k)\,k'=\frac{mc^3-2\,bdk-f\,k^2-b\,d^2}{f'}.$$

From these equations we find, by quadratics, the following general values for d, k and k'.

$$d=\sqrt{\frac{mc^3-2\,k\,k'f'-f'\,k'^2-f\,k^2}{b}+\overline{\frac{k'f'+kb}{b}}^2}-\frac{k'f'+k\,b}{b} \quad (1).$$

$$k=\sqrt{\frac{mc^3-2\,df'\,k'-f'\,k'^2-bd^2}{f}+\overline{\frac{bd+k'f'}{f}}^2}-\frac{bd+k'f'}{f} \quad (2).$$

$$k'=\sqrt{\frac{mc^3-2\,bdk-f\,k^2-bd^2}{f'}+\overline{d+k}^2}-d-k \quad (3).$$

When $f=f'$, as is generally the case in practice, we get by a simple reduction,

$$d=\sqrt{\frac{mc^3-f\times(k+k'^2)}{b}+\overline{\frac{k'f+kb}{b}}^2}-\frac{k'f+kb}{b} \quad (4).$$

$$k=\sqrt{\frac{mc^3-(2\,dk+k^2)f-bd^2}{b}+\overline{\frac{ba+k'f}{b}}^2}-\frac{bd+k'f}{b} \quad (5).$$

$$k'=\sqrt{\frac{mc^3-(b-f)\times(d^2+2\,dk)}{b}}-d-k \quad (6).$$

from which equations, by having any two of the widths a, k, and k' given, the other may be found.

Example 1.—Required the width of the main dam in Fig. 6, the depth of the water to be resisted being 30 feet, and the other dimensions as follows, viz. $f=f'=17$ feet; $k=7$ feet; $k'=10$ feet; and $b=33$ feet.

By equation (4) we have

$$d=\sqrt{\frac{\frac{125}{270}\times30^3-17\times17^2}{33}+\overline{\frac{10\times17+10\times33}{33}}}-\frac{10\times17+7\times33}{33}=\sqrt{\frac{12{,}500-4913}{33}-\overline{\frac{401}{33}}^2}-\frac{401}{33}=$$

$$\sqrt{229\cdot9+147\cdot6}=12\cdot2=\sqrt{377\cdot5}-12\cdot2=19\cdot4-12\cdot2=7\cdot2 \text{ ft.}$$

which nearly corresponds with the width of the principal dam in the coffer-dam used by Telford for building St. Katherine's docks, the other dimensions being taken from the transverse section given in the *Journal*, page 433, Vol. II.

Example 2.—Other dimensions remaining the same as in the last example, what is the value of k when d and k' are each equal to 7 ft.

From equation (5)

$$k=\sqrt{\frac{12{,}500-17\times(2\times17\times7+7^2)-33\times7^2}{17}+\frac{(7\times33+7\times17)^2}{17}}$$

$$-\frac{7\times33+7\times17}{17}=\sqrt{\frac{12500-2499-1617}{17}+\frac{350}{17}}-\frac{350}{17}=$$

$$\sqrt{493\cdot2+424\cdot3}-20\cdot6=\sqrt{917\cdot5}-20\cdot6=30\cdot3-20\cdot6=9\cdot7 \text{ feet.}$$

Example 3.—Other dimensions remaining the same as those in example 1, what is the value of k' when $d=7$ feet and $k=9$ feet?

From equation (6) we have $k'=\sqrt{\frac{12500-16\times(7^2+126)}{17}}-7$

$$-9=\sqrt{\frac{12{,}500-2800}{17}}-16=\sqrt{\frac{9700}{17}}-16=\sqrt{570\cdot6}-16$$

$=23\cdot9-16=7\cdot9$ feet.

When $f=f'$ and also $k=k'$, we find from equation (4) by a few easy reductions

$$d=\sqrt{\frac{mc^3}{b}+\frac{((b-f)k)^2}{b}}-\frac{(f+b)\times k}{b} \qquad (7).$$

also from the general equation of equilibrium, $2k^2f+2kfd+k^2f+2kdb+bd^2\times fk^2=mc^3=4k^2f+2kfd+2kdb+bd^2$, from which $k^2+\frac{bd+db}{2f}k=\frac{mc^3-bd^2}{4f}$, and by quadratics,

$$k=\sqrt{\frac{mc^3}{4f}+\frac{((b-f)\times d)^2}{4f}}-\frac{(b\ \ f)d}{4f} \qquad (8).$$

Example 4.—Required the width of the main dam in fig. 6, the depth of water being 30 feet, and the other dimensions as follows, viz. $k'=k=8$ feet, $f=f'=15$ feet, and $b=34$ feet.

From equation (7) $a=\sqrt{\frac{12{,}500}{34}+\frac{((34-15)8)^2}{34}}-\frac{(34+15)8}{34}$

$$=\sqrt{\frac{12{,}500}{34}+\frac{23{,}104}{1156}}-\frac{392}{34}=\sqrt{367\cdot7+20}-11\cdot5=\sqrt{387\cdot7}$$

$-11\cdot5=19\cdot7-11\cdot5=8\cdot2$ feet, the width required.

Example 5.—What is the value of $k=k'$ when the depth of water is 27 feet $f=15$ feet, $b=30$ feet, and $d=6$ feet?

From equation (8) $k=\sqrt{\frac{\frac{125}{270}\times27^3}{60}+\frac{(30-15\times6)^2}{60}}-\frac{45\times6}{60}$

$$=\sqrt{\frac{91{,}125}{600}+\frac{9}{4}}-4\cdot5=\sqrt{151\cdot9+2\cdot2}-4\cdot5=\sqrt{154\cdot1}$$

$-4\cdot5=12\cdot4-45=7\cdot9.$

Example 6.—What width shall we adopt for the main dam, the depth of the water being 18 feet, when $k=k'=5$ feet, $f=f'=12$ feet, and $b=21$ feet?

$$d=\sqrt{\frac{\frac{125}{270}=18^3}{21}+\frac{((21-12)\times5)^2}{21}}+\frac{(21+12)\times5}{21}$$

$$=\sqrt{\frac{2700}{21}+\frac{2025}{441}}-\frac{165}{21}=\sqrt{128\cdot6+4\cdot6}-7\cdot9=\sqrt{133\cdot2}-7\cdot9$$

$=3\cdot6$ feet, the width required. If $s=80$ lbs., we would find $d=4\cdot3$ feet; and if s was still farther reduced to 60 lbs., d would require to be increased to 6·1 feet.

It appears that the value of s in the foregoing formulæ greatly operates on the result in finding the width of the coffer-dam under its different forms. Unless where otherwise mentioned it has been taken at 90 lbs. in the examples given, but this value may be much reduced if water presses under the dam, and the reduction will be in proportion to the quantity of the bottom surface pressed upon, or exposed to the action of the water. As the construction of some forms of coffer-dams are more liable to admit water underneath than others, s may probably in such cases have to be reduced so low as 60 lbs.

The dimensions in the last example are nearly those of the coffer-dam used by *Semple* for constructing the piers of Essex Bridge, in Dublin, in 1753, the depth of water varying from 13 to 20 feet along the line of the coffer-dam. This coffer-dam deserves particular attention as being probably the first constructed in the kingdom, at that time, for such a depth of water; and from the difficulties the engineer had to encounter in the execution of the work, and overcoming one of the prejudices of the time then supported by the authority of a *Labylye*.

Figs. 7 and 8 show a plan and section of the coffer-dam taken from *Semple's Treatise of Building in Water*, which the author acknowledges to have taken from *Belidor's Hydraulic Architecture*. The piles are about 6 inches square, placed at 4 feet apart along the line of the dam, and sheeted along the inside with, apparently, inch boarding. B high-water mark, A low-water mark, D bed of river, C C occasional braces, f, g, and e, auxiliary braces, and P pudling. The width between the sheeting from out to out is 15 feet, and the main dam is 5 feet wide. This construction is however far inferior to that of continuous sheet piling as adopted at St. Katherine's Docks, and at the New Houses of Parliament; as the resistance, offered by the depth of bed penetrated by the pileing, is trifling in the former plan compared with that in the latter, but on the other hand the quantity of timber employed is less in the former.

Fig. 7.

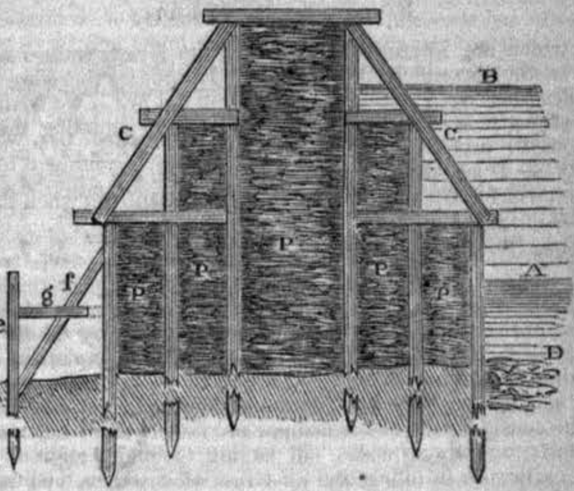
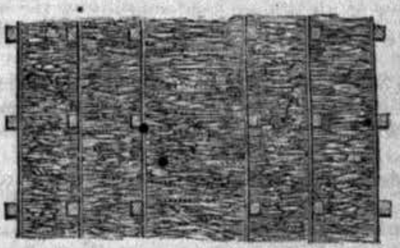


Fig. 8.



It may be necessary in conclusion, to remark that the depth of water ought to be taken from the surface to the bottom of the exposed coffer-dam, inside; for though that depth may not be on the outside, yet the water generally forces its way down so far; or if not, forces the bed with nearly an equivalent pressure against the coffer-dam.

Ancient Greek Manuscript.—An important discovery has been made by M. Didron, during his recent archæological tour in Greece and Turkey, of a Greek manuscript, about 900 years old, containing a complete code of religious monumental paintings. This document, found at Mount Athos, gives full instructions concerning all the subjects and persons that ought to be painted in churches, with the age, costume, and attributes that each figure ought to have. A copy of this manuscript is making at Mount Athos with the greatest care. Another manuscript, containing a similar code on religious architecture, is believed by M. Didron to exist at Adrianople, and he has some hopes of obtaining it.—*French paper*.

LONDON AND WESTMINSTER BANK.

WITH AN ENGRAVING, PLATE VIII.

The accompanying engraving originally appeared in the *Atlas*, from which also we are enabled to give the following description of the building.

This new building for the city establishment of the London and Westminster Bank, which was completed in the latter part of 1838, under the joint professional superintendence of Mr. C. R. Cockerell and Mr. William Tite, architects, is situated in Lothbury, immediately opposite to the Bank of England. The whole structure occupies a site of nearly eighty feet in frontage, and ninety in depth. The entrance front possesses, not only from its extent, but from its architectural treatment, a bold and imposing character. It displays, indeed, no columnar decorations, no hundredth edition of an approved portico; but its composition has the much greater merit of strict appropriateness, simplicity in general forms; such simplicity, we mean, as conduces to unity, together with a perfect expression of purpose; an air of solidity and strength, and a judicious equality of decoration. The façade consists of one general plane or face, broke only by an advancing pier at each end. It has seven apertures in the length, and three tiers of them in the height; the two lower tiers, comprehending the openings on the ground and one-pair floors, are included in one architectural story, or order, if such it may be called; the upper tier, which consists of the windows of the two-pair floor, being contained in an attic story. The whole of the front is of Portland stone, with the exception of the plinth, which is from the Bramley-fall quarries. To describe the front rather more in detail, we may state that the substructure is a stylobate, or continuous pedestal, resting upon a deep rock-faced plinth. From this stylobate rise broad pilasters, or rusticated piers, in courses of alternate widths; the whole including, as we have said, two tiers of openings, and surmounted by a regular entablature, the cornice of which is enriched with modillions. Of the seven compartments into which the front is divided, the central one is somewhat wider than the rest, and displays, on the ground floor, a handsome entrance doorway of large proportions, and deeply recessed, approached by several steps externally, and having the flight continued within. The remaining intervals afford six large windows, each being so wide as to admit of subdivision by two mullions and a transum of cast iron, of elegant design and novel structure; the isolated mullion partaking of the character of an antique candelabrum at the base, and finishing with a scroll or console at the top: very wide and lofty Venetian windows are thus obtained, without affecting the real or the apparent solidity of the fabric, and the great and important problem (as applied to the City of London), namely, to obtain the largest possible admission of light, with the smallest obstruction of solids or piers, is most effectually, and, at the same time, architecturally attained. These windows are furnished with Bunnett and Corpe's iron shutters. The windows above, upon the one-pair story, are narrower than the former, and consequently leave, on each side between the rusticated piers, intervals available for decoration: these are sculptured alternately with caducei, the invariable commercial symbol, and with the bundle of sticks, expressive of the *vis unita fortior*, so appropriate to the union, or joint-stock association, of this establishment. In consequence of the advance of the two end piers in the principal order before-mentioned, there is gained in front of the attic story, which is not similarly broken, sufficient space for the display of two statues of seated female figures, emblematical of the commercial interests of London and Westminster, and having shields charged respectively with the arms of those cities; a mode of applying statuary to the purposes of external decoration, enlivening and appropriate to the general structure, and effective as regards the proper development of the subjects themselves. These figures are designed (and one of them—that of London—we understand to have been modelled) by Mr. Cockerell, and executed by Mr. Nicholl.

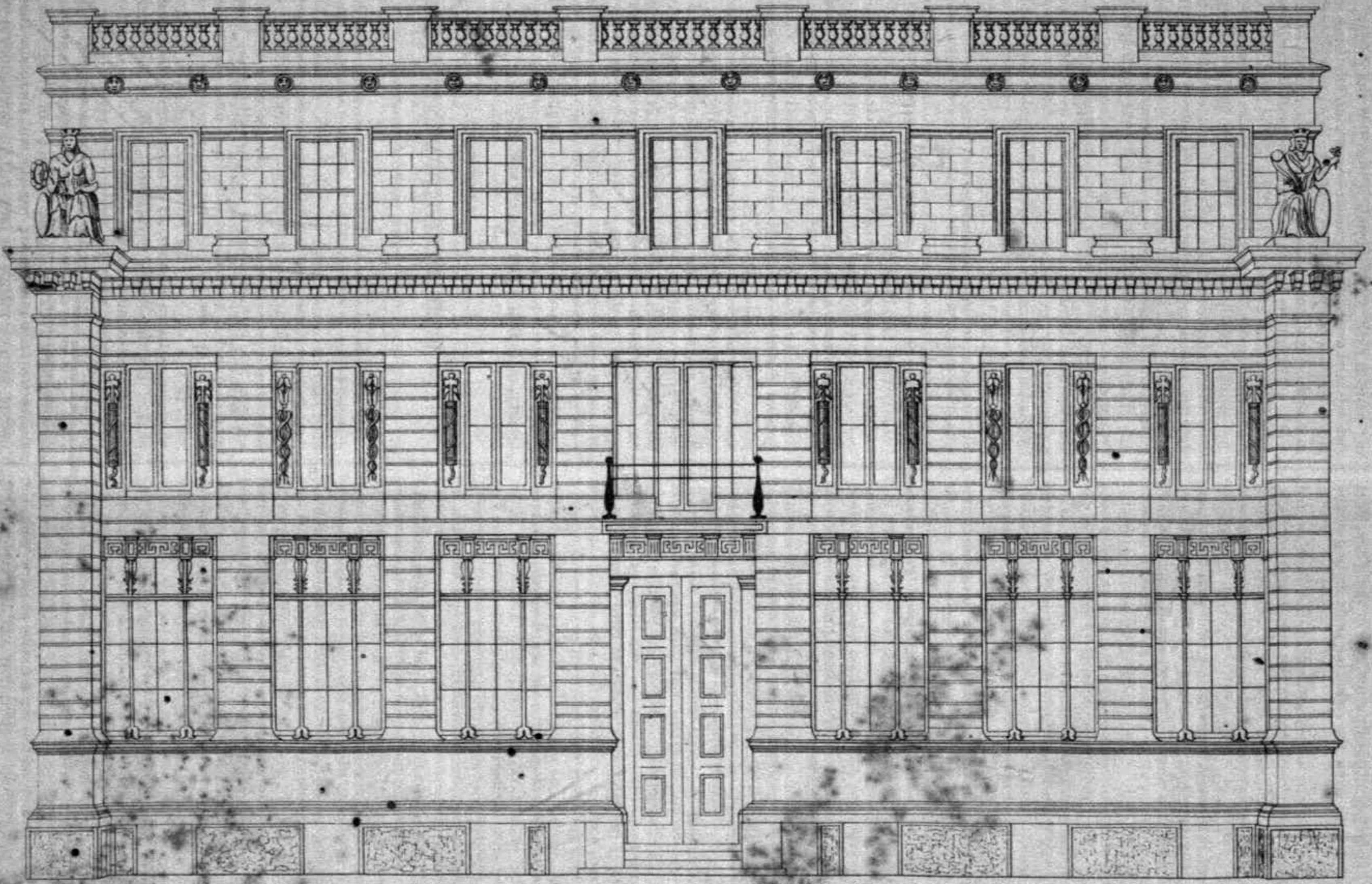
But it is time that we pass to the notice of the interior. The entrance vestibule or avenue has, on each side, a line of four plain Doric columns, with appropriate entablature and decorative mouldings. Its effect is, however, unavoidably impaired by the interference of two pairs of screen doors, though these are panelled and surrounded with plate glass, to obviate the objection as far as possible. From this ample vestibule, access is gained on the right to the country bank, the principal staircase, and some official apartments; and, directly in front, to the principal, or town bank. The latter apartment is not only by far the most considerable in the building, but is unequalled in importance by anything of the kind in London, except in the case of some offices of the Bank of England, and in altitude it exceeds even them. Its general form is a square of about 37 feet, whose height is that of the entire building—namely, 59 feet 6—and is extended by latera additions, east and west, to a portion of this height. These additions or aisles are divided from the centre, on each side, by an arcade of three arches, springing from Doric columns of the same size and order with those of the vestibule, with cornices. The columns themselves, in common with all the other features of the design, display a sober and subdued style of decoration or enrichment, being fluted only at the upper and lower extremities, and elevated upon plain flat plinths. The surrounding walls are channelled in rustic courses to the height of this order. The aisles or extensions are sufficiently lofty, by the arches raised upon the columns, to allow of the introduction of a gallery on each side, finished in front by a balustrade. Above this, the arches of the arcades run across over the aisles, and are intersected by a contrary vaulting, producing a system of groins as ceilings to the galleries; they are also advanced over the main body of the building, and treated as a series of half groins, so as to afford support to an upper projecting gallery, which passes quite round the principal square. The verge of this upper gallery is guarded by a simple, but handsome barrier, consisting of a double horizontal rail, sustained at intervals by ornaments of scroll foliage. Over this gallery the lines of the cubical form below are continued through, and gathered up, by means of pendentives, into a domed figure, exhibiting nearly that portion of a hemisphere cut off by planes raised upon the sides of a square inscribed within its circumference. The top of this dome is pierced by a large circular opening for a skylight, the margin of which is covered, and additionally ornamented with mouldings and lions' masks. Light is also obtained by triple windows, occupying the flat semicircular spaces left by the pendentives of the dome, on the three sides which are exposed to the view of a person entering, in the manner of the imperial Roman baths: these windows are filled with glass in geometrical compartments, alternately ground and polished. Smaller semicircular windows are introduced likewise in the three arches on the north side, which form a continuation to those of the lateral arcades, so that a very sufficient light has been contrived throughout this vast apartment, surrounded as it is with lofty and close buildings on all sides. Such is a general description of this apartment, the composition of which displays considerable novelty of adaptation, magnitude of proportions, and felicity of effect. The general forms are very happily diversified, and the decorative details distributed with equality; except, indeed, that the eye would have welcomed the application of some enrichment to the large expanse of the dome, which is left entirely plain. The fittings up are in a style of appropriate completeness; comprising handsomely finished and extensive ranges of counters; a massive central stove, of consistent design, being a bee-hive, round which the arms of London and Westminster, and the guardian of British commerce, as well as of goverment—the lion—are ranged with taste and propriety; an hydraulic apparatus, by which plate chests and cash boxes may be lowered into the basement story for security, or brought up with great facility, and other minor appurtenances.

RAMBLES BY PHILOMUSÆUS.—No. V.

THE BRITISH MUSEUM.

After this establishment has been partially closed for months, its directors have felt themselves compelled to show the public that at least they have not run away with the collections. They still keep the long gallery closed, and have thrown open two new galleries, in which a few unnamed articles are placed in undescribable confusion. We have seen representations of the plunder of a wreck by a crowd of savages, one with a pair of breeches in his arms, another with a coat matted round his waist, running from one package to another, ransacking their contents, and then throwing them about in confusion, and such is the state of the Museum. Egyptian coffins in one place, Etruscan tombs in another, all in most admirable disorder, the passages choked up, the rooms encumbered, and packages covered with the dust of months, accusing the inefficiency of the officers of the establishment. Nothing, perhaps, more nearly resembles the Spectator's description of a monkey in an Egyptian temple, ranging about not knowing what to do, and then establishing himself in a corner. That this institution has the active services of many men of the highest ability we fully recognize; we do not complain that there are not enough men of talent, we only call for the employment of more routine-working men. We are sure there are numbers of young men, sufficiently qualified, who, for a small remuneration, and many indeed for none at all, who would, under the superintendence of the officers, be competent to assist in the classification, without requiring a permanent employment in the establishment. We know that there is a great want of room, that the architectural department is sadly cramped,

PLATE VI



J. R. Jobbins, Warwick Court.

THE LONDON & WESTMINSTER BANK.

but we are convinced, notwithstanding, that there is a want of energy on the part of the officers, which throws the business into arrear, and paralyses the whole operations.

The Long Gallery has now been closed nearly a year, and the public thus shut out from the Portrait Gallery, the geological and mineralogical collections. At the same time we know that Dr. Mantell's collection of nearly thirty thousand specimens has been purchased, and ought long since to have been arranged. The Etruscan collection has remained in its present state during the whole of the last year, and thus has it been rendered totally useless. The Egyptian collection is, on the lowest estimate, two years in arrear, and the Vase Room good for nothing. As to the mammalia, their condition has been a subject of ridicule many years, and every month, by increasing the collection, renders the absurdity but more manifest. The managers of this department certainly deserve the highest praise for their compressive power, in which, doubtless, they have hardly yet met with a rival. An old bachelor's travelling portmanteau is nothing to it; cats crouching under lions, deer striding over wolves, the cases, crammed even into the crevices with stuffed animals, show a crowd of imprisoned and confused creatures, which even the ark of Noah could not equal.

With regard to what has been done, it has been little indeed. The arrangement of the Ægina marbles has been completed, the Phidian and Phigalian Saloons have been painted of a red granite colour, which, it is to be wished, may be continued throughout the whole house. The collection of fish, saurians, and batrachians, has been extended, and the insects and corallines removed. At Paris, a much greater number of entomological specimens is exhibited to the public, and so far is the respect even for vulgar curiosity carried, that the whole of the papilionaceous tribes are shown, forming a sight of natural beauty which is well calculated to strike the spectator with emotion. It is a national disgrace, that, ruling over one hundred and forty millions in India, we have no good collection of oriental objects, the illustration of our own antiquities is equally defective, and many departments flourishing in countries of less resources, are here totally neglected.

As to the catalogues of public collections in this country, with the exception of a portion of that of the British Museum relating to natural history, they are miserably defective, and inferior to what is done abroad. The catalogue of the National Gallery is a gross imposition, charging one shilling for a book which contains about one pennyworth of print and paper, and scarcely one farthing's worth of information. The catalogue of the Louvre, although necessarily restricted, gives much more detail, the name of the painter, of his master, the period at which he lived, the school to which he belonged, and a description of the subject. That of the National Gallery gives the name of the painter, and the date of his birth, and only the name of the picture, giving such references to the people as to a story in Tasso, and limiting the descriptive matter to a history of the picture, which, as many of the works are spurious or contemptible, is of no value. The catalogue of the antiquities in the British Museum is of no use, either to the artist or the public, giving the name of the statue, and barely that! No—a Mithraic subject! Who knows what that means, or who can tell where to find out. The catalogue of the Paris Museum of Antiquities, under the same circumstances, gives a page or two of small type to an account of the Mithraic rites. That catalogue gives, in every case, the name of the subject, extent of mutilations or restorations, history, stone of which made, height and breadth, and a full antiquarian and artistical account, with reference to the authorities of any peculiarity to be observed in the statue. To such an extent is this carried, that the catalogue is a complete encyclopædia of Greek and Roman costume, having the author's name attached to it, and invaluable to the student.

THE PUBLIC WALKS OF LONDON.

Much is said about the public gardens and walks of Paris, nothing is said of those of London, except by foreigners whom they never fail to strike with admiration. The Tuileries, the Champs Elysées, the Luxemburg, the Jardin des Plantes, and the Quais have great and incontestable merits, they possess features which we cannot rival, but those of London again are unexcelled in their own department. Each style is suited to its respective nation, perhaps it is a consequence of their several characters, perhaps a cause. We see at once the Frenchman in the classic statues, in the ordonnanced foliage, the imprisoned orange trees, and the straight walks. The Englishman seems to impress his own character in the grassy slopes, luxuriant timber, and placid waters of the scenes in which he epitomizes his beloved isle. The Frenchman knows no paradise without artifice, the Englishman none without nature, the American hates even the sight of a tree. That of which we have to complain is neither the grandeur nor extent of our public walks, but their unequal distribution. The parks were truly named the lungs of the metropolis, they are so, to the overworked mechanic they are receivers from which he obtains fresh breath to carry on his life-shortening labours. Yet as in the human being if we had an unequal distribution of the respiratory organs, we should find an atrophy of the body, so in the immense metropolis an insufficient provision of these necessaries of life causes an immense loss of human existence. The southern portions of the metropolis between Greenwich and Kew are miserably unprovided, but it is among the impoverished population of the east that the want is felt in all its severity. So great indeed is the difference between the average value of life in the east and the west of the metropolis, that whereas in the latter it is 2·1 per cent., in the former it is 3·2, and in Whitechapel it is so low that one female in twenty-four dies in a year, an awful mortality, scarcely perhaps equalled by Portugal or any other misgoverned country.

The walks of London may be divided into two classes, public and corporate, and the former again into special promenades and into thoroughfares and micellaneous sites used for this purpose.

Among the special promenades are to be reckoned St. James's Park, collection of curious birds, military monuments and music; Green Park; Hyde Park, military exercises and Kensington Gardens, military music; Regent's Park; Greenwich Park; Kew Gardens; Draper's Gardens, Throgmorton-street; Artillery Ground, City Road, military music; Tower Hill, recently planted; Lambeth Walk; Cheyne Walk, &c.

Among the other places used for walks are the old commons and greens as Islington and Kennington; Chelsea Hospital; the Cemeteries at Kensall Green, Highgate and Norwood; the Docks, &c.

We have not a line of Quais as at Paris, and we should be sorry indeed if we had, but we have points on the river affording unrivalled views:—the Dock Wharfs, Tower Wharf, Custom-house Wharf, Temple Gardens, Waterloo Bridge, the Adelphi Terrace, Hungerford Stairs, Millbank, Cheyne Walk, the Bishop's Walk (Lambeth), and the Terrace of Greenwich Palace.

Coming to the second class walks belonging to and used by communities, we have the unrivalled squares, the gardens of Lincoln's Inn, Gray's Inn, the Temple, Charterhouse, &c.

These many establishments place London almost without a rival in the provision for this department of public health, and in the beauty of many of the establishments and their accessaries, as well as in the splendour of the views which they afford,—unique prospects of one of the largest cities and ports in the world.

GOVERNMENT MEASURES FOR STEAM VESSELS.

It was with regret that we learned that on the first day of the session the government gave notice of their intention to bring in a bill for carrying out the recommendations of the Steam Vessel Inquiry Commission. This report has now been long published, and so far from attracting the support of those who have examined it, it has excited either open hostility or silent contempt. We had occasion on its appearance to call the attention of our readers to its provisions, we pointed out the meanness and paltriness of the means by which it was attempted to be supported, and the injurious results which must infallibly ensue from the enactment of its provisions. A case of grosser jobbery, or more iniquitous misrepresentation than is presented by the report was never hardly brought before the public. Had indeed the necessity of inquiry been so great as to require investigation only to ascertain the extent of injury, a case would at once exist for the appointment of a commission, but when no such necessity existed, when no evils prominently called for redress, it was but a gross mockery of public credulity, and an arbitrary exercise of delegated power to invest men of whatever standing with authority, which they received as it were with permission to direct for their own personal advantage. What was it but calling on the commissioners to make out a case not only to justify their present employment, but to give them occupation for the future, to do as they have done in this case, to use every artifice of an accuser to overwhelm the object of pursuit? Has even common respect been paid to the judgment of the public, common justice been shown to the victims of this persecution? facts of trivial insignificance have been overrated and overstated, a judicial investigation has resorted to absurdities to bolster up a false cause, popular prejudices have been appealed to, insufficient and untried examples have been enforced as of authority and example, in fine the dignity of the government and the people has been outraged, the prosperity of the country threatened, and the vested interests of property attacked. And for what purposes but the grossest? To furnish new places at the expense of the best interests of the country, to subject the genius of its inventors and the characters of its manufacturers to an inspection more servile than degrades even a French police; to stifle ingenuity, to give a monopoly to ignorance and indolence, to cripple the energies of the nation, and in striking at one branch, to prepare a chain for all.

We have on previous occasions exposed the misrepresentations and fallacies of this report with an unsparing hand, and therefore refrain from enforcing on our readers arguments, of the truth of which they are well persuaded. We may observe that admitting all the statements of the commissioners to their fullest extent, they are but arguing from the abuse against the use, they are seeking to upset the great principles of English administrations, and to foist in foreign degradations; they are endeavouring to substitute for the grand principle of protecting the mass against the errors of a few, that of sacrificing the whole body to correct trifling abuses, a system which while it is being abandoned abroad, is endeavoured for the first time to be introduced here. Founding their claims upon untried or inefficient precedents, they call for powers greater than even these examples authorize, and make up by boldness of demand for the weakness of their cause. They rely upon the examples of the United States and of France, they dare to bring forward that of Belgium, they conceal that other circumstances prevail in the States, that the laws of France are inefficient and unobserved, and that Belgium has no vessels for which to legislate.

This measure ought not to be, cannot be, carried; its results are too evidently mischievous to allow us to believe that the parties affected can be so deaf to their own welfare as to allow it to be carried into effect without resistance. We call upon them, therefore, to unite, to meet together and concert measures for the defeat of a project so odious and so ruinous; it is only by union that this can be effected; it is thus the aggressions of government have been successfully resisted by the railways and other interests. We earnestly advise, therefore, that immediate steps should be taken for calling a meeting of the boat-builders, engine-makers, and steam-boat captains, and of all those who have property embarked in this large and increasing branch of the shipping interests.

THE STATUE OF HUSKISSON.

BY JOHN GIBSON, R. A.

[We are indebted for this able paper to the kindness of our eminent and talented correspondent at Rome, whose love of art is only equalled by his knowledge of it.—EDITOR.]

We have much pleasure in announcing that Mr. Gibson is engaged in executing another statue of Huskisson, which, we understand, is to be placed in the Custom-house, at Liverpool. This statue differs in some respects from the former one executed some time ago, in as much as that, the attitude is different, and we think that it is more dignified, and seems to breathe the true Attic spirit of a great orator, both statues however partake of the character of the Demosthenes of the Vatican, and the Aristides[*] of Naples. The latter was so famous that Demosthenes accused his rival Eschines of imitating it, or an antique statue that resembled the Aristides, by folding his arm in his pallium when he addressed the public from the rostrum.

As the former statue of Huskisson was sacrificed from the fact of its having been placed in a temple of too small dimensions, we therefore shall offer a few observations, lest the one we now are about to describe should share the same fate. The first statue was composed in such a manner as to allow of its being seen in any point of view, and it necessarily followed, that the temple should have been of that magnitude, to have enabled a spectator to have encompassed with his eye the entire figure on walking at a sufficient distance around it, whereas it was found necessary to place it with its back to the wall. Thus it is that the skill of the sculptor displayed in the composition has been miserably defeated by the ignorance of the architect; in consequence of which the statue can only be seen in one point of view, and that, the most unfavourable, remaining enshrined in stone, hid from vulgar eyes, like the oracle of Delphi. The height of the statue should have given the architect the scale of proportions for his temple. Arrian's description of the Pontus Eurinus, says that the statues and images placed in a sacred edifice should always be in proportion to it, as being a part of it. "Quod enim ad membra sacrarum ædium etiam statuæ earum atque imagines pertineant, decet nos Arrianus in ipso statim invitio peripli ponti Euxini." The proportions of temples with regard to the statues which were to be placed in them was strictly observed by the ancients. The Emperor Adrian objects to the statues of Mercury and Philesius in the temple of Trapesuntia, as being less than the just proportions which the temple required. "Ibi enim Adrianum Imper; certiorem facit Mercurii ac Philesii statuas in Trapesuntiorum templo minores esse, quam pro ipsius templi ratis debeant." Bad artists place small statues upon large pedestals, thus showing their own ignorance. Vitruvius says[*] all the parts of a sacred edifice must agree in each single part with the general height of the whole.

Trusting this second statue will not share the same fate, we will now proceed to describe it. The statue, like the first one, is colossal, Huskisson is represented standing in an easy and dignified attitude. the right leg a little advanced, his arms are naked, and the left one is raised towards his face, whilst the right arm hangs by his side, and in the hand he holds a scroll. The breast is naked, while the drapery falls within a short distance of his feet, and is brought over the left shoulder. The attitude is becoming the senatorial dignity of a great statesman, and is at once quiet and impressive; from the stern and meditative air it might be almost imagined that he was about to summon up to his bidding all the resources of his gigantic mind, and that he had grown a colossus in power,—that Demosthenic eloquence was about to burst from his lips. The head which we believe is a faithful portrait, has all the artistical attributes which are indicative of genius, approaching to the beau ideal of a philosopher, the expression of the face is severe, and the features are vigorously pronounced, the cold marble is made to breathe with a soul, nay almost with human intelligence. The nude is true to nature, yet all traces of mechanical art and vulgar impurities have been effaced by the magic touches of a chisel directed by the master hand of another Phidias, it has made the marble start into immortal life. The entire figure would seem to have been cast in that mould in which the Greeks were wont to form their heroes and their gods. The drapery is consonant with the subject, masterlike in style, easy and flowing, it is in fact the Greek pallium, consequently classic, and hence suitable to assist at the apotheosis of a great statesman. Huskisson like another Aristides,[†] has now had a statue raised to his memory for having caused by his eloquence the embellishment of that city which gave him political fame during life, and immortality after death. He is fortunate too in having for his artist a fellow-citizen so distinguished. In the drapery of Gibson's figure we find that it is disposed with judgment, while the skill shown in the arrangement of the folds gives a rich effect, and the harmony of the lines serve to preserve a proper balance of light and shade. We also remark that the angular creases, and the spirited touches of the details contribute to the grand effect of the whole. To arrange drapery is one of the most difficult branches of the art, sculpture cannot as in a painting, imitate the nature of the stuff, and give the various shades of colour which have their origin from the reflection of light and shade.

Quatremere de Quincy observes, "that ancient clothing is employed by art, not as ancient but as natural, not because it was adopted by the Greeks and Romans, but because no other can be employed in imitation; and further not even so much because it is accordant with the metaphorical style, as because the modern costume is anti-imitative. This being the case, the interest of every nation requires that in confiding to the sculptor the task of perpetuating its exploits, and its great men, it should watch over the taste and the style of imitation in works, which while they inspire respect for the images so enshrined, may bear favourable testimony to future ages of the period at which they were upraised."

No reasoning can be stronger than this, and we think the observations of the above cited learned author irrefutable, but we will repeat that the modern style of dress is wholly inconsistent, and quite unworthy of the dignity of sculpture, and we shall find that whenever it has been attempted, whatsoever might have been the style of dress of the period, classic taste has been ontraged and every principle violated which is the characteristic of beauty in art. The object of sculpture is not to give an individual portrait dressed up in the whimsical or the ephemeral fashion of a day, but to perpetuate the memory of persons by investing the lasting marble with the attributes of that classic style of art, which has been handed down to us by those whose works yet stand omnipotent, and have outlived the wreck of time. Sculptural portraiture in fine was considered by the Greeks and Romans as a convention, at once allegorical and imaginary, sometimes it represented the metamorphosis of the gods, or the apotheoses of princes, warriors, orators, poets, and philosophers. The statues of

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[*] From some very recent discoveries we believe that this statue called Aristides, is Eschines himself.

[*] Vitruvias, lib. 3, cap. 5.

[†] When Smyrna was destroyed by an earthquake, Aristides wrote a letter so pathetic to M. Aurelius that he ordered the city to be immediately rebuilt, for which intercession a statue was in consequence raised to the orator.

Alexander, Adrian and Antinous are naked, and were made ideal gods, they like the statue of Pompey, seem to have a mystic life, there is a very language in those cold, stern, and colourless stones, which breathes an air of truth and creates on our minds more interest than their names in the pages of history. The statue of Napoleon,* by Canova, is naked, and is an apotheosis; it is confessedly, grand, imperial, and collossal; it has immortalized the hero, as well as the artist, and when we consider that Canova and Gibson were the first to set so good an example to their country, we must say that their statues will ever stand pre-eminent over the barbarous objects which disfigure some of our public monuments.

We would ask is there a person capable of reflecting who has paced the vast sculpture gallery at Versailles, and not smiled at the absurd dresses of some of the marble effigies; in days gone by they were admired, and the persons they represented were doubtless, much venerated, but alas! how changed, they now excite our contempt, and we feel inclined to laugh outright at their antiquated costumes. The time will come, and it is not far distant, when the vagaries of our sculptors will share the same fate, and become also objects of ridicule. It is an opinion held by some artists that all monuments should have the figures executed in the style of dress of the period in which they were erected, but we feel sorry to observe that it is only interested and inferior artists who advocate this opinion, and it is because they find that to model drapery and the naked proportions is excessively difficult, and often beyond their capacity, they are therefore contented to please the ignorant multitude, who for the most part, like the cobbler could only criticise the sole of the shoe in the picture of Apelles, for which reason persist in perpetuating the fame of our generals and admirals in all the glorious absurdity of modern tailory—epaulets and cocked hats, boots and spurs. Of what possible consequence can it be to us that antiquarians should discover in after times that pig-tails were commonly worn in the reign of George the Third? and moreover, that it was a most singular custom with their ancestors to represent great warriors in a mutilated state, having only one arm, and sometimes wooden legs. This they would conjecture was done to bring to the recollection of the public that they had lost their limbs in the service of their country. Lest the time may arrive when even the name of a Nelson should be blotted out of the page of history, we would recommend that his amputated arm be placed by his side, to convince future ages that he was once a perfect being, and furthermore to satisfy the public who ever crave after monstrosities,† the arms and legs of his brave comrades might be piled up in a group as monumental trophies of their valour! Non eadem miramur!!

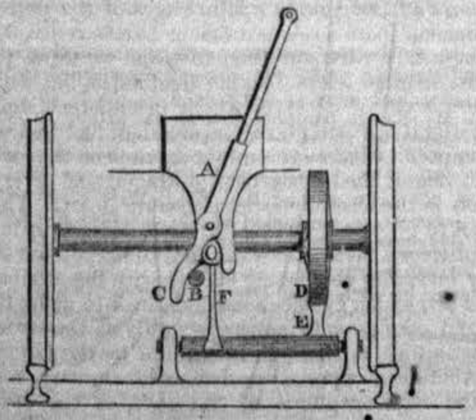
Felagrio.

Rome, January 18, 1840.

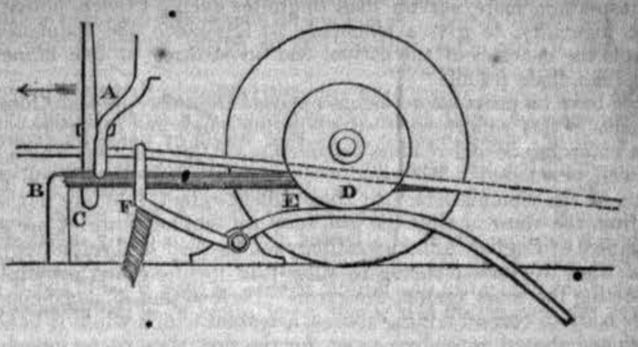
DIOGENES'S SELF-ACTING GROUND-ROPE APPARATUS,

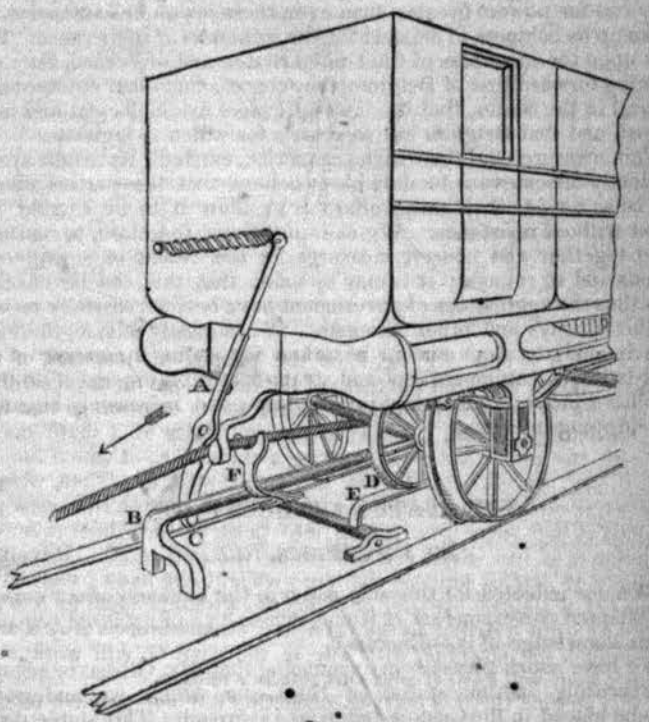
FOR TAKING UP THE ROPE.

Front View.



Side View.





REFERENCE TO THE LETTERS.

A	Claws or holder for the rope.
B	Bar for forcing open the claws, in order to liberate the rope, or previous to taking hold of it.
C	Lower part of claws, which works against the bar B.
D	Small wheel fixed upon fore axle of carriage to elevate the fork.
E	Lever over which the wheel D passes, and forces it down.
F	Fork fixed on the same axle as the lever just mentioned; but by being on the opposite side, it is raised as the lever is depressed; it is pulled down again by a spring It is to raise the rope to the level of the claws; were the claws fixed lower, they would catch against the pullies. It should be observed that the fork is not raised until the claws have passed it. The rope is liberated by a similar bar, only the fork for lifting up the rope is omitted.

THE EPICYCLOIDAL STEAM ENGINE.

[We have given this communication at the request of some of our readers, although it is not new, as we stated in our notice to correspondents. The motion will be found described in the second volume of Gregory's Mechanics, and the author there states that it was introduced in an engine erected at Bermondsey. It may be seen as we before stated at the Saw Mills in the Arsenal at Woolwich.]—Ed.

Sir—I am happy to communicate my improvement on the steam engine.

In all engines now employed the motion of the piston rod is communicated by a connecting rod to the crank. This rod, by the nature of the motion always works obliquely. The obliquity of action is certainly objectionable, as it evidently occasions a loss of power.

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* This fine statue of Napoleon is in the possession of his Grace the Duke of Wellington, at Apsley-house.—Ed.

† We have *dogmatical* proofs that the French have outgeneralled us in sculptural atrocities, for in the triumphal arch of Napoleon at Marseilles, there are *poodle-dogs*, and a whole legion of amputated *arms and legs*.

Accordingly, the connecting rod is always made as long as may be, within limits fixed by other circumstances, for thereby the obliquity of its action is diminished. A method of communicating the motion of the piston to the crank, without loss of power by such a cause, has therefore been a *desideratum*.

The fundamental principle of my contrivance is, that the epicycloid generated by any point of the circumference of a circle rolling on the interior of the circumference of another circle of twice its diameter, is a straight line, the same point always describing the same straight line. Thus, the circle A B F, fig. 1, rolling on the circle A C A′, in the above-mentioned circumstances, any point, A in it, moves up and down A A′, a diameter of the larger circle. It is easily inferred too, that the centre E, of the inner circle describes a circle E G, of equal radius concentric with the larger circle; so that, were E and F connected, the connection E F would move round F, in the manner of a crank.

Fig. 1.

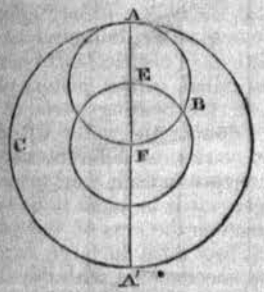
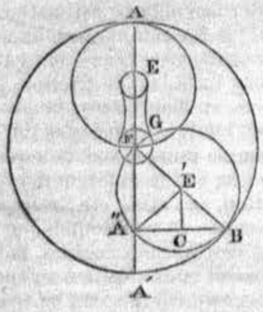


Fig. 2.



Now, let A A′ and A F, fig. 2, be the primitive diameters of two teethed wheels, in which the teeth of the larger one on the interior of the circumference, and those of the smaller on its exterior, so that they may run into each other. Let G be the extremity of a shaft concentric with the wheel A A′, and carrying a crank G E, of which the pin at E is also concentric with the smaller wheel A F. Then, when G revolves, it carries the wheel A F with it, which runs on the crank pin, its teeth at the same time taking into those of the wheel A A′, and the point A of the wheel A F describing the path A A′. Reversing the mode of action, suppose the large wheel to be fixed; then if the piston rod of a steam cylinder of which the stroke is equal to A A′, be jointed to a pin standing on the primitive circumference of A F at A, for example, the machine, with a fly on the shaft G, will work, so as that this shaft will have a continous rotatory motion.

In this method there is neither connecting rod nor parallel motion. The piston rod is connected immediately with the pin on the wheel A F, and is led up and down rectilineally by the very nature of the motions.

Now, the fact that no special parallel motion is required, proves that none of the power is wastefully exerted. To be more minute, however, suppose the crank in the position F E′, fig. 2, A′ A″ will be the piston rod, jointed at A″ to the wheel. Producing F E to B, this will be the touching point of the two circles. Draw A″ B, A″ E′, and drop the perpendicular E′ C upon A″ B. Then A″ E′ B must be considered as a crooked lever of the second kind, in which B is the fulcrum, and E′ and A″ respectively, the points of application of the resistance and power. Now, in the triangles F E′ A″, A″ E′ B, the angle E′ F A″ + E′ A″ F (or 2 E′ A″ F, 5. 1. Euclid) = 2 right angles — F E′ A″; and E′ A″ B + E′ B A″ (or 2 E′ A″ B, 5. 1. Euclid) = 2 right angles — A″ E′ B (32. 1. Euclid). And taking the half sum of these equations, we have E A F + E A B = 2 right angles — (F E′ A″ + A″ E″ B) = 1 right angle; that is, A″ B is perpendicular to A′ A″, and therefore, A″ B is the leverage of the power acing in the line A′ A″. C B is also the leverage of the resistance acting in the line E′ C; and it is easily seen that A B = 2 C B; so that, as this demonstration applies in every position of the crank, putting the angle A″ F B′ = Z, and F B = 1, we conclude, in general, that,

1. The leverage of the power $= \sin. Z$;

2. resistance $= \dfrac{\sin. Z}{2}$;

3. The line of action on the crank is always parallel to the piston rod. Now, as could easily be proved, by this mode of action, namely, the parallelism of the impulse on the crank, the whole power of the piston is communicated to the main shaft; and thus is my object proved to be attained.

Besides the advantage already stated, this engine possesses two others, simplicity of construction, and smallness of bulk. It differs from the common ones in this also, that with the same sweep of crank, it has twice the length of stroke; and accordingly, as we see from the above two fixed conclusions, the leverage of the power is twice that of the resistance.

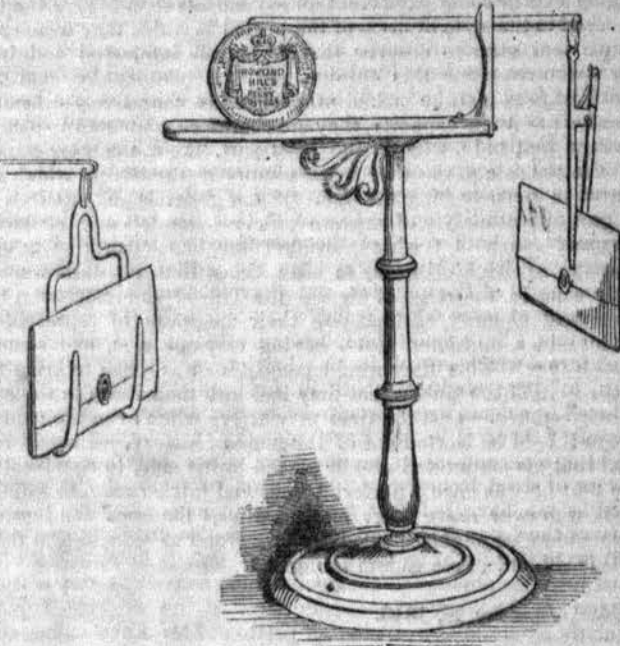
I am, Sir, your obliged servant,

DANIEL CLARK.

Glasgow, Dec. 19, 1839.

HOOPER'S POST OFFICE LETTER WEIGHTS.

THE accompanying engraving represents one of Hooper's peculiar letter balances, the merits of which are its simplicity and accuracy; a grain in effect would turn the balance either way. Although numerous devices have been introduced for this purpose, none that we have seen surpass this in utility, in which it is as much before its competitors, as it was in priority of introduction.



THE FITZWILLIAM MUSEUM.

THE Fitzwilliam Syndicate have reported to the Senate:

"That Mr. Basevi has certified to the Vice-Chancellor that Mr. Baker has executed works in the building of the Fitzwilliam Museum to the value of £34,000 or thereabouts; and Mr. Basevi has thereupon recommended that a sum of £5,000 be now paid to Mr. Baker on account of the said works in addition to the sum of £25,500 already paid to him on that account.

"That although the above-mentioned sum of £5,000 exceeds the instalment which Mr. Baker is at present entitled to demand according to the terms of the contract; the Syndics, under the circumstances stated in [*]Mr. Basevi's certificate and letter, beg leave to recommend to the Senate that the said sum be paid to Mr. Baker, provided that he is willing to agree that the balance to be retained by the Vice-Chancellor until six months after Mr. Basevi shall have duly certified the entire completion of the works, shall according to the terms of the contract, be not less than 10 per cent. upon the whole amount of the contract; and that Mr. Baker's sureties are willing to agree that the payment of the sum of £5,000, as above proposed, shall not affect or impair their present liability under the contract."

The Syndics further recommend;

"That Mr. Basevi be authorized to order the execution at a cost not exceeding £1,000, of certain works at the Fitzwilliam Museum not included in Mr. Baker's contract; it being advisable that such works should be completed previously to making any further contracts for the finishing of the building.

R. TATHAM, *Vice-Chancellor.*

W. FRENCH. G. PEACOCK.
G. AINSLIE. J. HAVILAND.
J. GRAHAM. H. PHILPOTT."

At the Congregation this day, a Grace will be offered to the Senate to confirm the above Report.

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[*] Mr. Basevi's certificate and letter will be laid on the Registrar's table.—*Cambridge Advertiser.*

EXPLANATION OF SOME TECHNICAL TERMS USED IN STEAM ENGINE CALCULATIONS,

WITH REMARKS ON THE CORNISH QUESTION.

SIR—The full and satisfactory account you have given in your February number, of the new engine at the East London Water-works, must not only be highly interesting to those of your readers who are attached to pursuits connected with the steam-engine, but also to those who value truth for its own sake, inasmuch as it will very soon settle the long-disputed Cornish question, besides being of the greatest practical importance to the proprietor of mines and other large works in all parts of the kingdom.

It now appears that in my comparison of the Cornish and Lancashire systems in your number for January, I had, as indeed I wished to do, rather over than under-rated the power of the engine above referred to, and when I have all the data for going into the commercial part of the question—the comparative expense—I am afraid it will be found that the advantage of the Cornish system has been somewhat more largely overrated by others, especially with reference to the propriety of adopting that system in cotton factories. At any rate, when the proper corrections are made in my table of comparative duty, from the statement you have furnished, I think no one will be found to contend that *four*, *five*, and even *six* times more work (as has been often asserted) is performed by the steam-engines in Cornwall than in the north of England for the same quantity of fuel of like quality. Indeed, the excessive degree of perfection hitherto claimed for the Cornish engine is much to be regretted, even if true, as it carries a certain degree of absurdity on the face of it, that has not a little indisposed engineers on both sides of the question to a fair and dispassionate inquiry. With a view to expedite the settlement of the most important parts of the question, and prevent that divergence from the main point at issue which is liable to occur with the best-intentioned disputants, I have made the following attempt to define certain technical terms which prevail in this district, and it will be of use, perhaps, to some engineers both in and out of Cornwall. I am also induced to submit these definitions to the approval of your readers, because I observe, in Mr. Enys' remarks in your last number, a few slight misconceptions of my meaning, which, together with perhaps a want of strict accuracy of application in some of the expressions used by me, have led that gentleman to underrate the comparative duty of the Lancashire engine; there are also errors in his statement that go to the disparagement of the *Cornish* system, which I am sure must be quite obvious to that gentleman, as well as the rest of your readers, on the slightest reconsideration of the subject—I more particularly allude to the concluding portion of Mr. Enys' communication. No guess work allowances are at all requisite either for "vacuum imperfections" or engine friction and resistance in my estimate of the Lancashire engine, as the load on the piston of 10 lbs. per circular inch was not the calculated, but the *observed*, steam pressure taken by the indicator, as I distinctly stated, and it of course includes the friction of the engine, shafting, &c. The average steam pressure acting on the piston of the pumping-engine, was, on the other hand, not observed, but *calculated* to be 10·65 lbs. per circular inch, which would be the difference of pressure between one side of the piston and the other, due to the given load on the other end of the beam, including of course a small allowance for the friction of the engine itself, as was required to render it equivalent to the indicator pressure; but no allowance was required in this case, any more than in the other, for "vacuum imperfections." I purposely chose this method of avoiding the risk of making erroneous deductions from what I think is properly termed the "gross horse power," so that a more just comparison of the two systems might be obtained. Possibly some allowance may be required for pit-work friction, but as Mr. Enys seems to think that nearly equivalent to deficient water delivery, the omission cannot make much difference.

From the corrected data now given by Mr. Wicksteed, it appears that the load in the shaft, 66,443 lbs. must be reduced for the leverage of the beam in the proportion of 10 ft. 3 in. to 9 ft., or to 58,398 lbs. and this sum, *plus* an allowance for friction, is the gross load in the cylinder, instead of 68,160 lbs., which I had before assumed from the data then furnished to me. The proper substitutions corresponding to this correction being made in my table of "Comparative Duty," it will be seen that the latter will be materially altered in favour of the Lancashire system.

For the purpose already stated, and also in order that a clear understanding of the meaning intended to be conveyed in future, when comparing the power or economy of steam engines, it seems necessary that some technical terms commonly used by engineers and others should be strictly defined. The following are definitions of such as are used in reference to the power of the factory or cotton mill engine; and I trust that some of our Cornish friends will favour us with a similar elucidation of the equivalent terms that obtain in Cornwall, such as "duty, efficiency, &c."

The "*nominal power*" is what an engine is called by its maker, and Mr. Watt's standard, it is well known, was that due to an effective pressure of steam in the cylinder of 6 lbs. per circular inch, and a speed of 220 ft. a minute for each horse power. The "*gross power*" is the total power exerted by the steam in the cylinder, including that required to work the engine itself, or to overcome what are called the friction and resistances of the engine, and is equivalent to the whole force of the steam acting on the piston against a vacuum more or less perfect; or, in other words, it is the force resulting from the average difference of pressure between one side of the piston and the other; this average is that obtained by the indicator, and it is in general sufficiently correct for all practical purposes. The indicator pressure, it will be observed requires no correction or allowance for what are called vacuum imperfections, such allowance only being required when, for want of indicator experiments, the steam pressure in the cylinder can only be estimated from that in the boiler. The "*effective power*" is the total power exerted by the engine, or delivered at the crank shaft, after overcoming its own friction. This friction, of course, not only includes the friction, properly so called, of the piston, pump buckets, stuffing boxes, &c., as well as all the bearing parts of the engine, but it also includes the resistances due to the water lifted by the engine pumps, and is a quantity that varies in different engines according to the different degrees of excellence in their workmanship, situation, and other circumstances. In general it is found to be equal to from one to two pounds per circular inch on the area of the piston in the best modern engines, but in a much less ratio in large engines than small ones. When an engine can be unconnected with the shafting, its own friction can be readily ascertained by the indicator; this, however, would only be what M. Pambour properly calls the "*unloaded* friction," for, of course, the friction of nearly all the bearing parts of the engine must increase with the load in some ratio corresponding to the goodness of workmanship. This *loaded* friction is variously estimated by different engineers, at from one fifth to three tenths of the gross load; and Tredgold estimates it at about ·238 of the whole of the force of the steam in the boiler, or with the resistance to the steam in the passages, the loss of power by cooling, &c., included, he calls it ·368 of that force (see Tredgold, new edition, page 196). Although the unloaded friction of the engine, when the speed of the latter admits of being easily regulated, is capable of correct ascertainment, as I have already stated, yet it is rarely so obtained in factory engines separately from the friction of the shafting; but when so obtained and deducted from the gross power, the result gives a certain amount larger than the real effective power, by so much as the loaded exceeds the unloaded friction of the engine. This result has been proposed to be termed the "effective *indicated* power."

The "*net effective power*," or available power of an engine, is usually understood to be the power delivered at the machine pulleys, or that which is effective or available in turning the machinery, exclusive of that required to turn the shafting, the straps, and the loose pulleys. The friction of the shafting, when ascertained by the indicator, (the machine straps being thrown on the loose pulleys) is of course the unloaded friction, and as in the case of the unloaded engine friction when deducted from the effective power, leaves a result for net effective power somewhat greater than the truth; this result, however, has been proposed to be denominated the "net effective *indicated* power." This last is what is meant when the number of horses power required to turn any given portion of machinery is said to be ascertained by the indicator. It is always understood to include so much of the friction of the engine and shafting as is due to the increased load, and is commonly, and I think properly, termed the "*indicated horse power of the machinery*." It is also sometimes called "available" power, but evidently without due consideration, that term being only strictly applicable when used to signify the net effective power, and which may be ascertained in many cases independent of indicator experiments.

Should it meet with your approbation, I shall be glad to furnish you with practical illustrations of the above remarks by indicator, diagrams, and calculations taken from engines now at work in this county, previous to going farther into the consideration of the question of the *economy* of the Cornish system.

I am, Sir,
Your obedient servant,
R. ARMSTRONG.

Manchester,
Feb. 11*th*, 1840

STEAM APPARATUS.

Sir—Having had my attention drawn to the notice of my drying machine in your Journal of this month, page 28, and conceiving that your editorial remarks is calculated to withdraw attention from it, I beg to trouble you with the following explanation :—

The application of steam heat to the purposes of drying is very common, as every one knows; but, in all cases that I am acquainted with, its *direct* application is *to the air* in which the goods intended to be dried are exposed—that is, they are hung up in a heated air. Ventilation is essentially necessary in every operation of drying; but the ventilation which carries off the moisture evaporated from the wet goods, carries off also, a portion of the heated air before it is *saturated* with moisture. There is, therefore, a waste of caloric, or heat, in all systems of drying with which I am acquainted. My object has been to avoid this—to prevent any particle of caloric generated from escaping without performing its duty. The mode adopted in this machine, is not to heat the air, but to hang the drying goods close to the pipes which generate the heat, and in such a manner as shall form an entire sheet, *closing in* and *covering* the pipes. In this case it is evident that no heat can escape *without passing through the wet goods*, for the heat is on one side only of the drying material, which on the other side is a current of air which carries off the moisture as fast as it is expelled. It is by this economy of heat that we are enabled to dry 150 sheets in an hour in the small machine at Abingdon.

The principle may perhaps be better understood by any one acquainted with the common mode of drying woollen clothes in stoves. It is well known that the usual length of a piece of cloth is about 40 yards, and that the rack on which it is hung in a stove is *doubled* in two parallel lines 6 or 7 inches apart, to avoid an extreme length of building. The cloth when hung is stretched on this rack, so forming a double line with an interval of 6 or 7 inches; into this interval or between the double rack, pipes are introduced, the top of the interval being closed by a piece of board connecting the double rack.

It is thus clear that the heat generated from the pipes can escape only *by passing through the cloth*. So effectual is this mode found in the extensive manufactories of Messrs. Wilkins and Co., near Bath, that a cloth which used to be four hours in drying, is now dried in three quarters of an hour, while the fuel is diminished two parts out of three. It follows also, of course, that from the rapidity of the changes, one-fourth of the space formerly required is now sufficient.

As applied to the drying of wool the same advantage is discernable. In this case the pipes are laid under a perforated floor, and the wool so disposed that the ascending heat *may pass through it*. By this means two rooms are found to dry more than was formerly done in six.

I am, Sir, your obedient servant,
James Wapshare.

1, *Great Bedford Street, Bath.*
January 29, 1840.

A PARISH CHURCH BURIED IN THE SAND FOR 700 YEARS, LATELY DISCOVERED.

(From the Churchman.)

Of the many objects to which the attention of your readers is drawn, in the various departments of your paper, there is not one which can exceed in interest the following account of the church of Perranzabuloe, or St. Peran, in the hundred of Pydar, in the county of Cornwall. For more than seven hundred years it had been imbedded in the sand, from which it was rescued, in the year 1835, by the persevering exertions of a private gentleman, William Mitchell, Esq., of Compregny near Truro; and there are many considerations which render a description of the church, in the state in which it was found, very opportune and seasonable at this moment; for its present state affords presumptive and internal evidence of the fallacy of some of those pretensions in which the members of the Romish communion indulge, as to the antiquity of the church, and the pomp and splendour of their services. It would be no difficult matter to prove, by authentic documents, that the first three centuries furnish not the slightest authority for those pompous ceremonies, and those puerile observances which were introduced, and which still continue to outrage the simplicity of the primitive worship. With respect to this particular church, the sand has been accumulating for many hundred years, but when completely removed, the church was found in the most perfect state; and it is a very singular circumstance, that the interior contained none of the modern innovations and accompaniments of a Romish place of worship, from which the evidence is clear and indisputable, that it must have been built at a period anterior to the introduction of the numerous corruptions, &c., of the Papistical communion, and gives sanction to the well authenticated fact, that, in the first three or four centuries, not one of those puerilities and observances, borrowed either from Pagan idolatries or the Jewish ritual, were known; for the truth is, what we see in Romish places of worship, is nothing but a transfer of what we read from the synagogues of the Jews, or the temples of the Pagans; and which outvie in particular, in splendour and magnificence, the sacerdotal vestments with which those were apparelled who officiated either in the one or the other. The whole of their service is an appeal more to the external sense, than an address to the understanding and the affections. There was no rood left for the hanging of the host, nor the vain display of fabricated relics, no latticed confessional, no sacring bell (a bell rung before and at the elevation of the host,) no daubed and decorated images of the Virgin Mary or of Saints, nothing which indicates the unscriptural adoration of the water, or the no less unscriptural masses for the dead. The most diligent search was made for beads and rosaries—pyxes and Agni Dei—censers and crucifixes. Strange that this ancient church, in which it will be borne in mind, everything was found as perfect as at the time in which it was first imbedded, should so belie the constant appeal to *antiquity*—to the *faith* of their *forefathers*—to the *old religion*, as it is falsely termed, as if that were religion which has not a particle of the simplicity and purity of the primitive church, to sanctify and identify it as a branch from the true apostolical tree! At the eastern end, in a plain, unornamental chancel, stands a very neat but simple stone altar, and in the nave of the church are stone seats, of the like simple construction, attached to the western, northern, and southern walls. With such humble accommodations were our fathers, who worshipped God, in simplicity and truth, content!

From the amiable and intelligent historian of the past and present condition of Perranzabuloe—the Rev. C. T. Collins Trelawny, a descendant, on the maternal side, of the good Bishop Trelawny—a name of which he may well be proud—one of the seven of the glorious company who preferred the gloom of a prison before submission to the mandates of an arbitrary papistical tyrant,—I have had an interesting letter, in which, in answer to my inquiry as to the present state of the parish church, he informs me that it is not in a condition to admit of its being used for any purpose whatsoever, as it is already again entombed in the sand! It was with extreme regret that I received this communication; for so much had my interest been excited by Mr. Trelawny's narrative, which is beautiful and will well repay many a perusal, that I was on the point of fulfilling arrangements I had made for a summer visit to the venerated spot; but I hope that the same enterprising spirit by which it was five years since resuscitated as it were, and recalled into being, will be again interposed to rescue it from its present entombment, and be a temple yet appropriated to the service of the living God! I know not the localities; but who in such a wish does not join? and where is the man whose piety would not grow warm as he worshipped within the hallowed pile of Perranzabuloe, as much as it would within the mouldering ruins of Iona? It may not, perhaps, be unimportant and uninteresting to add, that the tutelar Saint of Cornwall was Peranus, or St. Perran, after whom the imbedded church was named, and that the memory of this saint is still cherished with fond veneration by the people of Cornwall. His annual commemoration is celebrated on the 5th of March. Christianity was first preached in Cornwall by Corantinus, by whom the whole of the population was rescued from Pagan idolatry, and converted to the Christian faith, at the end of the third, and at the commencement of the fourth century.

James Rudge, D.D.

Hawkchurch Rectory, 18*th Dec.* 1839.

ARCHITECTURE AT HOME AND ABROAD.

[We select the following remarks on architecture from an interesting paper which appeared in the last *Foreign Quarterly Review.*]

Owing to the great impulse which has been given to building, since the peace, we have now, throughout the country, a show of very respectable bits of architecture—things of rather ambiguous or negative merit;—Gothic made neat, Grecian made homely, Italian softened down to insipidity. In art our ambition is of a staid, modest, and reasonable kind. Among all our recent works we have few of monumental character, that is, such as testify honourably to the power and taste of the age in which they were produced: scarcely any thing that is really imposing in point of scale, and not less imposing and dignified in style. Our classical school is mechanically correct, frigid, an mannered: we must not look to it for genialty of conception, masterly originality, or happiness of invention. What beauties it gives us are almost altogether borrowed;—transcripts of good originals as regards individual features, which are, however, seldom more than merely put together, instead of being so combined as to produce an ensemble with one and the same spirit pervading every part, a kindred feeling diffusing itself throughout. Owing to an unfortunate littleness and feebleness of manner, buildings large in themselves do not make an impression at all proportionate to their size, but are reduced to the minimum of effect. For grandeur and majesty of aspect Buckingham Palace will hardly bear comparison with that lately erected at Brunswick; and which though by no means unexceptionable, proves Ottmer to be as superior to Nash, as Brunswick is inferior to Great Britain. What the former looks like, or rather does not look like, we all know too well; but the other has a princely air that bespeaks the residence of a sovereign.

Contrasts of this kind are likely to pass for invidious, more especially when they happen to be unfavourable to ourselves; yet the best way of preventing such is by taking a salutary lesson from them for the future, and endeavouring to be first where we now stand almost last. If, however, only to show that we wish to be impartial, and do not blindly defer to the authority of names and reputations, we shall here bestow some notice on the Königsbau, or new palace at Munich, numerous plans and other engravings of which may be seen in the Bauzeitung for 1837. We need scarcely disavow any prejudice *against* Klenze, for we have been charged with being much too favourably disposed towards him our comments, therefore stand a chance of being received as free from bias either way.

The principal, or indeed, only façade, namely, that forming the north side of the Max-Josephs-Platz, extends in a perfectly unbroken line for the length of 406 feet (English). It is 65 feet high, except in the centre, where the height is increased to 95 by the addition of another order, for the extent of eleven windows, or somewhat more than half the length of the front: there being twenty-one windows or apertures in each of the other stories. So far there are the elements of grandeur—length, continuity, loftiness; and when we add to these, massiveness, both with regard to the relative proportion of solid and void, and that arising from the character of the style employed, namely, the older Florentine, it will be taken for granted that it is not at all deficient in greatness of character and the qualities allied to it. Nevertheless we are dissatisfied, less for what it is than for what it is not. Scarcely any pretension whatever is made to originality; the whole is too direct and close an imitation of the Palazzo Pitti; the character also is palpably borrowed and assumed, with this additional drawback of being altogether exotic, and not at all in unison with anything else. As a monument, the original is a highly interesting and impressive work of architecture; as a study, most valuable; as a model, most unfit,—that is, for a palace in the nineteenth century. Recourse might have been had to the same style, but it ought we conceive, to have been differently treated,—in many respects considerably modified; and required a livelier and more captivating expression imparted to it. Instead of this, the physiognomy given to the edifice is by far too repulsive and stern: simplicity has been carried to severity, uniformity pushed to monotony, and to the exclusion of play or contrast of any kind. Moreover, its close general resemblance to the Palazzo Pitti is apt to provoke a disadvantageous comparison, because after all it falls considerably short of that edifice in its mass; at the same time that it is deficient in the powerful contrast produced in the other by the greater solidity there of the lower part. We do not approve of architectural duplicates, more especially when an opportunity offers for a masterly and original production. Such opportunities are far too precious to be negligently thrown away, and ought to be turned to account by creating something that shall carry art onward, and, if possible, give it a new and invigorating impulse.

These objections are no way diminished when we discover that instead of the façade preparing us for the interior, it is quite in opposition to it; the decorations throughout the latter, both architectural and pictorial, being scrupulously, not to say affectedly, Grecian, both in style and character. By Wiegmann, Klenze has been reproached with inconsistency for having in the Glyptotheca employed vaulted ceilings and other forms of Roman architecture within a building externally professing to be purely Grecian:—this, we must say, savours rather of hypercriticism. But in the case before us there is a positive clashing of opposites, because though the apartments are in every other respect perfectly Greek in style and taste, their circular-headed windows contradict it, and disagreeably remind the spectator of the still more decided difference between the taste of the exterior and that of the interior. This, however, is a trivial blemish compared with one very serious and pervading effect; namely, that of the plan altogether, which so far from presenting any kind of beauty, any originality, contrivance, variety, contrast, or play, is exceedingly commonplace and monotonous, and is inconvenient withal as can well be imagined. It is divided on each floor into two enfilades of rooms, all rectangular, either square or oblong, without any intermediate communication, except one part where there is a narrow passage for domestics. As far as arrangement goes, not the slightest attempt has been made at effect. Not only are the principal rooms nearly of the same form, but nearly all of the same size, and so disposed as to occasion inconvenience, and exclude effect also. This will hardly be disputed when we say that the centre of the enfilade in the front of the building divides into a series of small rooms, having only a single window each; and being appropriated as the king's and queen's bed-rooms, dressing-rooms, &c., entirely cut off all communication between those on either side of them. Thus, so far from any climax being produced, all sort of focus and centralization is destroyed, and the parts are disunited and scattered. In fact the whole of this floor can be considered as consisting only of private apartments, notwithstanding that both on the king's and queen's side there is a throne-room preceded by two or three ante-chambers. With the exception of the rooms at either extremity of the front, all the others must be inaccessible to those whose immediate personal attendance on their majesties does not give them the privilege of passing and repassing as there may be occasion of doing.

We will not be quite sure that fresco-painting, when employed to the extent which it is throughout Munich palace, is altogether the very best mode of decoration, or calculated to give the greatest importance to the architecture. For particular rooms and in certain situations, it may be suitable enough; but it is hardly so for sitting rooms, where paintings upon such a scale are apt to become too obstrusive, and by their subjects forming too harsh a contrast—sometimes perhaps almost a ludicrous antithesis—to the familiar details of social life: the opposition becomes that of poetry to prose. A mere picture does not force itself so conspicuously upon the attention; it may be gazed at or not, studied or overlooked; but paintings which constitute, so to say, the local scenery of the whole space, put forth a too direct claim to notice; and though they may be interesting to the casual visitor, cease to make so much impression after constant familiarity. A great deal may certainly be said on both sides; we shall therefore only observe that as decorations for the walls of sitting rooms, subjects in fresco ought, we conceive, to be employed with some reserve, and not suffered to occupy too great a space of surface. In this opinion we are borne out by one who must be admitted a competent authority on the subject, and who has not scrupled to question the propriety of some of the most noted works of the kind. "The far-famed Loggie of the Vatican," says Hessemer, "which ever since they first existed, have been extolled as the greatest models of decoration, are in fact not decoration at all, but a series of paintings covering the surface of both walls and ceilings. As a whole they possess no architectural character; and if the separate pictures, allegories, &c.. have very little intimate connection with each other, they have, as such, still less with their situation and with the building itself. As offering an instance of the greatest contradiction between locality and decoration, may be mentioned the works of Giulio Romano in the *Palazzo del Te* at Mantua, with regard to the pictorial but *non-decorative* merits of which I forbear to make any further comments."

After our animadversions upon the Königsbau we can hardly be charged with being indiscriminate partisans of the "Bavarian Ictinus;" nor is it without concern we are compelled to admit that the talents of Klenze have not always been in proportion to the opportunity afforded, or in correspondence with the generous ardour of his royal patron. For the faults we have pointed out we are not indebted to his opponent Wiegmann: since he bestows no notice on any of Klenze's buildings, except merely *en passant*, with brief and general censure, and without entering at all into particular criticism. So far his pamphlet has disappointed us, for though the title makes no specific promise, we did expect that, whether for eulogy or the reverse it would furnish—if not a biography, yet something like an account of the architect's professional career. Instead of this, the writer confines himself almost entirely to the consideration of Klenze's principles and theory, as illustrated in his collection of designs for churches, entitled "Christiche Bauart." Of that production we cannot trust ourselves to speak, not having the volume by us to refer to, nor now recollecting more of it—after a single inspection—than that we considered the designs of rather mediocre quality, and betraying a want of study. The specimens there given of Greek architecture as applied to that class of buildings appeared to us by no means happy models, nor calculated to instruct, as they might have done, had the motives of each subject been explained. As little are we able to say whether the severity of Wiegmann's remarks,—his fastidiousness and captiousness are justified by anything he himself has done, or by greater success attending his own principles; to confess the truth, it is not very clear to us what the latter really are, or what at times he means to say. We may however venture to assert that several of his remarks come home to others besides Klenze, and who, equally bigotted in favour of Greek architecture, are still more cold and pedantic in their application of it; formal copyists, who do not even attempt more than a mere reflection of the antique, and that only in particular features; and while certain forms are scrupulously imitated, fidelity as to the genius and real spirit of the style affected is usually lost,—perhaps held matter of no account. The consequence is that the things so produced are more of less failures—neither antique nor modern—not a skilful adaptation of both, but a harsh and disagreeable conflict of opposing elements and contradictory ideas. Little does it avail for an architect to exhibit the most perfect Grecian portico or colonnade, if he at the same time lets us see that he has trusted to that alone;—that so far from being a necessary portion of his structure, it is a mere adjunct which, though certainly not so intended, chiefly forces us to feel its own vast superiority over all the rest; and the difficulty, if not impossibility, of making that which ought to be principle harmonize with, or even seem worthy of, what is engrafted upon it. Almost invariably do architects forget that by such adoptions they tacitly bind themselves to raise every other part in the same spirit, and to display such powers as shall excuse their appropriating the merit of others to themselves, by making it truly part and parcel of their own work.

Unless this last can be effected with ability, the antique forms will seldom be more than something hung about a modern building,—extraneous parts;—not a consistent dress in which the whole is attired, but mere trimmings and appendages; intended to pass for architectural style, but oftener making it all the more manifest, how deficient the building itself is in character, and destitute of all that conduces to style. Nay, if, on the one hand, columns and other Greek decorations display the great superiority of classical taste, on the other, they lose much of their original value and charm, by being associated with what but ill accords with them. Many a modern soi-disant Greek building reminds us of Cicero's witty question to Lentulus: "Who has tied you to that great sword?"—for with us the question might frequently be: Who has tied that plain and insignificant building to that classical portico?—It also generally happens that such feature is itself impoverished, in order that the contrast between it and the rest may not be too ridiculously glaring.

Diametrically opposed to Klenze, who considers Grecian or Greco-Roman architecture—for he does not reject the Roman arch—to be the only style adapted for universal application, Wiegmann contends that the adherence, or the attempt to adhere, to pure Greek forms in our present and totally different system of construction, is no better than pedantic affectation; and that they ought no longer to be retained by us as models. He further asserts that there can be no such thing as a permanent and unchangeable style in architecture, and that the endeavour to revive at the present day any by-gone style whatever is an absurdity, and very much like trying to force a stream to flow back to its source. According to him, only that which is perfect matter of indifference in itself, and has nothing to do with style, can be indiscriminately adopted as suitable to all times and all occasions. In this there is a certain degree of truth, but somewhat of perverseness also; for a style based upon Greek architecture must upon the whole be allowed to run more in unison with modern taste generally, and prove more capable of application to every diversity of purpose, than any other we are acquainted with. At all events Wiegmann himself has not even attempted to point out how we are to extricate ourselves from the perplexities of his doctrine. He is not one of those who would discard Grecian in order to make way for Gothic, because he rejects the one just as much as the other. Neither do we exactly know how far he really objects to the Greek style, or under what limitations he considers its adoption allowable or even beneficial. That he admits the latter to be possible, is, however, apparent from the commendations he bestows upon Schinkel, observing:

"He is an inspired venerator of Grecian art: but instead of adhering to its externals alone,—to what was more or less conventional in it, and arose out of the circumstances of the times in which it flourished—he has actually penetrated into its very spirit, and in more than one of his works has shown that the rationality and beauty arising out of construction,—which stamps the works of the Greeks as superior to all others, may be made to display themselves even at the present day; and that notwithstanding the great difference between them and the structures of antiquity in regard to many particulars of design, such works partake infinitely more of the same spirit than do the ill understood and lifeless imitations of which Klenze has furnished us so many," viz. in his Christliche Baukunst.

How the above passage can be very well reconciled with the apparently unqualified rejection of Greek architecture even as a type for us moderns, is a point we must leave to Herr Wiegmann himself to explain. In admitting that it is possible to catch the true spirit and genius of Grecian architecture, and to infuse them into buildings adapted to widely different purposes from those of antiquity, he admits that all we ourselves contend for; and in fact, so far advocates the very course we ourselves would uphold;—since few can be more strongly opposed than ourselves to that cold, formal, lifeless imitation of Greek models, which amounts to nothing more than the most servile and tasteless species of copying,—slavishly correct as to certain particulars, but egregiously incorrect—absolutely licentious, in all that regards taste and feeling. We certainly should have been far better satisfied had Wiegmann explained himself so fully as to remove all apparent contradictions, and to leave no room whatever for doubt; still more, had he confined himself more strictly to architecture, instead of entering into vague metaphysical inquiries with regard to the nature and power of art generally, while he is so brief and obscure in regard to many points connected with the former, and which it is highly desirable that either he or some one else should render perfectly clear. What he chiefly proves is, not that Grecian architecture is altogether inapplicable at the present day—such doctrine being wholly at variance with the very high commendation bestowed upon Schinkel for the happiness with which he has in many instances made use of it;—but that the designs in the Christliche Baukunst are nearly all more or less defective, notwithstanding that they were put put forth as models for the instruction of others, nor was their author at all fettered in his ideas by any of those circumstances which generally interfere in the case of actual buildings. After all, therefore, the more important question is left poised in equilibrium, as much being conceded on one hand as is denied on the other. Very little notice, again, is bestowed on the buildings actually erected by Klenze, notwithstanding that many of them—not only the Pinacotheca and Neue Residenz, but Prince Maximilian's Palace, Kriegsministerium, Post Office, &c., are almost entirely in the Italian and particularly in the Florentine style; yet whether the Munich architect's practice is on that account to be considered much more sound than his theory, we are not explicitly told, but left to guess it as well as we can. Now this indistinctness and indecision are to us highly disagreeable: if Wiegmann thought he could even demolish Klenze altogether and give the death-blow to his theory in recommendation of Greek architecture, he should have shown himself more in earnest; and instead of saying a very great deal that amounts to nothing, should have stuck to the main point, and there battered away. If he wishes to have it understood that Klenze is little better than a charlatan in art, he should have put—or tried to put the fact beyond doubt,—should have left us no middle course, but have either compelled us to adopt, or called upon us to refute his arguments.

We are, indeed, favoured with opinions as to one or two of the structures erected by Klenze at Munich; yet mere opinions are very different from argument and criticism: they may be correct or erroneous, just or unjust, but, if received at all, must be taken entirely upon trust, at least by those who have either not the means, or else not the ability, judging for themselves. Thus, Wiegmann dispatches the Königsbau very summarily, calling it a "verballhornten Pallast Pitti;" and again, condemns the Glyptotheca as an unhappy combination of a pure Greek temple with a prison-like mass of building. If it is the absence of windows that constitutes the prison-like character complained of, the same comparison may be extended not only to the temples, but almost all the other public edifices of the ancients, that are remaining; while if some other circumstance produces this effect, it might not have been amiss to explain it to us. Is Wiegmann of opinion that the wings of the façade are too low for the portico?—that, instead of rising above the rest, the portico would have appeared more of a piece with it, if merely stuck on to the building, and made to jut out from it, the whole front being kept of the same height throughout? Or does he think that some windows both within the portico and on each side of it would have improved the whole,—have mitigated the too temple-like character of the one, and the too prison-like aspect of the other? This is what he does not care to inform us; neither does he afford the least clue as to what he considers a more harmonious combination, by referring to something else as an example of it. The most therefore, that we can say in his excuse is, that he is kept in countenance b a great many others who seem to think that the mere expression of praise or blame is sufficient for architectural criticism.

This last remark applies far more strongly than we could wish to the Allgemeine Bauzeitung, where of the various buildings that have been represented and described, scarcely one has had any comments made upon it. Yet this suppression of criticism can hardly have been occasioned by overstrained delicacy, because several would have afforded opportunity for descanting upon the merits of their design. Among these are the Buchhändler Börse at Leipsic, erected by Geutebrüch, the architect of the Augusteum, 1834-6; and Dr. Härtel's house in the same city, by Waldemar Herrmann of Dresden. Both are in a rich Italian style; and of the two the latter has somewhat the superiority as to extent of façade, its front being 112 feet (English), in length, while that of the other is 108. Besides which it has very much the air of a public building, as there is only a principal floor with an open Corinthian loggia of five intercolumns, above the ground-floor or basement, while the loggia itself is decorated with compartments in fresco. As far as style and beauty of external architecture go, there is scarcely a private mansion in all London that can compete with it, certainly not one of recent date; for even Sutherland House is but a very plain and frigid piece of design in comparison; and both Norfolk House in St. James's Square, and Buckingham House, Pall Mall, are absolutely homely. To say the truth, it may fairly challenge almost any one of our Clubhouses,—at least of those already erected,—for we must not as yet include the Reform Club, whose façade promises to eclipse all its neighbours. We call attention to this example all the more, because we have nothing similar at home: on the contrary, so far from any stimulus having been given of late years to architectural display in the town residences of our nobility and persons of fortune, it would rather seem that the trumpery show and flaring tawdriness of the Terraces in the Regent's Park, and other barrack-like ranges of buildings of that class, have brought the system into disrepute; and it certainly must be acknowledged that the plain and perfectly unassuming brick fronts of houses far more costly and spacious than those just alluded to, have a far more aristocratic look than the others, whose grandeur is nothing more than overgrown littleness, and meanness tricked out in the coarsest finery: truly they may be described as the very Brummagem of architecture.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

ROYAL SOCIETY.

Dec. 19.—Major Sabine, R.A. V.P., in the chair.

A paper was read, entitled,

"*An Account of Experiments made with the view of ascertaining the Possibility of obtaining a Spark before the Circuit of the Voltaic Battery is Completed,*" by J. P. Gassiot, Esq.

The author of this paper adverts to the fact, of a spark invariably appearing when the circuit of the voltaic battery is completed; an effect which Dr Faraday has shown can be easily produced, even with a single series. He then refers to the experiments of Mr. Children, Sir Humphry Davy, and Prof. Daniell, recorded in the Philosophical Transactions; in which experiments, when more powerful and extended series were used, the spark was obtained before contact took place. In order to ascertain, not only the fact of a spark being obtained, but also the distance through which it may be passed, the author had an instrument prepared, which he denominates a *Micrometer Electrometer*, and by which an appreciable space of one five-thousandth of an inch could be measured with great accuracy. He describes this instrument; and relates several experiments which he made with a view to test the correctness of its action. He first prepared 160, and then 320 series of the constant battery, in half-pint porcelain cells, excited with solutions of sulphate of copper and muriate of soda; but although the effects, after the contact had been completed, were exceedingly brilliant, not the slightest spark could be obtained. He was equally unsuccessful with a water battery of 150 series, each series being placed in a quart glass vessel: and also with a water battery belonging to Prof. Daniell, consisting of 1,020 series; but when a Leyden battery of nine jars was introduced into the circuit of the latter, sparks passed to the extent, in one instance, of six five-thousandths of an inch. The author mentions his having been present at the experiment of Prof. Daniell, on the 16th of February, 1839, when that gentleman had 70 series of his large constant battery in action; and having been witness of the powerful effects obtained by this apparatus, he was induced to prepare 100 series of precisely the same dimensions, and similarly placed: but although this powerful apparatus was used under every advantage, and the other effects produced were in every respect in accordance with the extent of the elements employed, still no spark could be obtained, until the circuit was completed; *even a single fold* of a silk handkerchief, or a piece of dry tissue paper, was sufficient to insulate the power of a battery, which, after the circuit had been once completed, fused titanium, and heated 16 feet 4 inches of No. 20 platinum wire. The author then describes a series of experiments made with induced currents. 1,220 iron wires, each insulated by resin, were bent into the form of a horse-shoe. A primary wire of 115 feet, and a secondary of 2,268 feet, were wound round the iron wires. With this arrangement he obtained a direct spark (through the secondary current), sufficient to pierce paper, to charge a Leyden jar, &c. Several forms of apparatus employed by the author are next described, and also a series of 10,000 of Jacubone's piles. With this arrangement he charged a Leyden battery to a considerable degree of intensity, and obtained direct sparks of three-fiftieths of an inch in length. He ultimately succeeded in obtaining chemical decompositions of a solution of iodine and potassium: the iodine appearing at the end composed of the black oxide of manganese.

Jan. 9.—J. W. Lubbock, Esq., V.P. and Treasurer, in the chair.

A paper was read, entitled,

"*On the Construction and Use of Single Achromatic Eye-Pieces, and their Superiority to the Double Eye-Piece of Huyghens.*" By the Rev. J. B. Reade, M.A.

The author observes, that experience has shown it to be impracticable to make a telescope even approach to achromatism by employing the same object-glass with an astronomical, as with a terrestial eye-piece; for if the focus of the blue rays from the object-glass be thrown forwards, as it must be, in order to make it impinge upon the focus of the blue rays upon the terrestrial eye-glass, then there will be produced a great *over-correction* for the astronomical eye-glass, and *vice versâ*. Hence it appears that the application of Huyghenian eye-pieces to refracting telescopes are incompatible with the conditions of achromatism throughout the entire range of magnifying power: and that, in reflecting telescopes, they are incompetent to correct dispersion, because they are not in themselves achromatic. These defects the author proposes wholly to obviate by substituting, for the Huyghenian eye-pieces, single achromatic lenses of corresponding magnifying power, consisting of the well-known combination of the crown, and its correcting flint lens, having their adjacent surfaces cemented together; thus avoiding internal reflections, and enabling them to act as a single lens. The achromatic eye-pieces which he uses were made by Messrs. Tully & Ross, and are of the description usually termed *single cemented triples.*

"*Meteorological Observations made between October* 1837, *and April*, 1839, *at Alten in Finmarken.* By Mr. S. H. Thomas, Chief Mining Agent at the Alten Copper Works; presented by J. R. Crowe, Esq., H. B M. Consul at Finmarken; communicated by Major E, Sabine, R. A. V. P. This memoir consists of tables of daily observations on the barometer and thermometer, taken at 9 A.M., 2 P.M., and 9 P.M., with remarks on the state of the weather at Kaafjord, in lat. 69° 58′ 3″ N., and long. 23° 43′ 10″ E. of Paris.

J. Whatman, Jun,, Esq., was elected a Fellow.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

Jan. 20.—Edward Blore, V.P., in the Chair.

A paper was read,

"*On the History of Græco-Russian Ecclesiastical Architecture.*" By Herr Hallmann, architect, from Hanover.

Before examining the existing Russian churches, the author thought it necessary to take a hasty glance at the origin and history of Christianity in Russia, or what amounts to the same thing, at the histoty of those churches. One of the first Christians in Russia was the Princess Olga, who caused herself to be baptized at Constantinople in the year 964; but the era of Christianity in Russia did not commence before the reign of Vladimir the Great. The first church which he caused to be built was that of Cherson, and, a year afterwards, he ordered the construction of the Church of St. Basil, which was, as well as the other, of wood. He sent an embassy into Italy, Arabia, and to Constantinople, to examine the various religions, for the Western and Eastern churches were already separated from each other; and Prince Vladimir, embracing the Greek religion, ordered the baptism of the whole of his people, and was the first to commence destroying the ancient idols. Vladimir built the church of the tithe at Kief; and it is said that, at the time of his death, there were already 500 churches at Kief. Prince Yaroslaf turned his attention still more than Vladimir to the construction of religious edifices; he founded the churches of St. Sophia, at Kief, and another, of the same name, at Novogorod:—they exist, in part, to this day. He also erected the convents of St. George and St. Irene. In 1075 was built the celebrated convent of Petchersky, at Kief, since which time the Russian metropolitans remained subordinate to the metropolitans of Constantinople. Christianity made rapid progress; there remained an uninterrupted communication between Constantinople and Kief, and various marriages between the two reigning houses of the two countries were celebrated. About the year 1124, a great fire destroyed 600 churches and monasteries. In the civil war under Yisaslaf, Kief was taken; it was set on fire: and finally, nearly at the same time that Constantinople was taken by the Venetians, the city of Kief was ravaged and destroyed a second time, never again to realize its former splendour. Moscow is first mentioned in the year 1154, and at that time it was but a miserable village. Daniel of Moscow added to it greatly; and, in the year 1304, under John Danielowitsh, the city was chosen capital of the empire, where, on the 4th of August, 1326, was laid the first stone of the church of the Assumption of the Virgin, in the Krimlin. Under Dimitri Donskoi, the palace of the Krimlin, until then of wood, was erected in stone; and under the reign of Basil the Blind (1425-1462), the church of Russia ceased to be dependant on that of Constantinople, after the taking of that city by Mahomet II. In the year 1487, a palace, known by the name of the Granite Palace in the Krimlin, was built, and in 1499 the Belvedere Palace. Ivan IV. did much for the arts (1534-1584). He likewise renewed the laws for exactly imitating the ancient painting in new churches, whence the reason why all the paintings are so much alike that it is impossible to judge of the epoch, but they may be regarded as a sure type of the earliest Christianity. About the year 1600 the Tzar Boris caused the erection of the magnificent clock-tower, Ivan Valiki, at the Krimlin; and at this period Moscow reckoned 400 churches, of which 35 were at the Krimlin alone. From the time of Peter the Great, and particularly at Petersburg, a change of style took place, and the type of the ancient church was replaced by the absurdities of the *rococo*.

After this general view of the progress of Christian art in Russia, the author turned to the consideration of the Russian church itself, and for this purpose he chose for his examination the cathedral church of the Assumption of the Virgin, at Moscow, as holding the middle rank amongst the existing churches, both as to form and time of construction. (1326.) The plan of the church forms an oblong square divided, and the vaults of which are supported by six equal columns in the interior. Upon a first glance, the form of the Greek cross is not noticed, but it is indicated by the arrangement of the cupolas. The more ancient churches often form an exact square preaeded by a porch, but here the porch is united with the interior of the church, and the arches of the cupolas are placed as if the church still retained the primitive form. The six columns divide the church into four parts from east to west, and three from north to south. On the eastern side are seen three apsides, only divided by the width of a pillar. The middle apsis is bigger than the side ones; this arrangement is found in nearly all the Greek churches, and these apsides indicate the situation of three altars, which are met with everywhere except in small chapels. The altars are not visible to the public; they are covered or concealed by the iconostasis, an arrangement peculiar to the Greek church. This iconostasis (or image-bearer) is merely a kind of colossal skreen, occupying the whole width of the church, thus dividing it into two different parts. The iconostasis has three doors, a principal one in the middle, and two smaller ones on each side. Behind the lateral doors there is a more particular distribution, which is, that on each side stands a second little iconostasis, occupying only the width of the little apsis, but the arrangement of which, with three doors and an altar behind, is analogous to the great one. This is what is met with in the ancient churches; in the more modern, an alteration has been made, so that at the farther end of the edifice are seen, upon the same line, three different distinct iconostasis. Between the principal door and the lateral ones, there is, in front of the iconostasis, on each side, a place for the choristers. Above and before the iconostasis always rises the principal cupola, and in the cathedral churches, at the foot of the apsis, opposite the iconostasis which support the cupola, are seen on the left a baldachin for the emperor, and, on the right, another for the metropolitan. As to the situation of the cupolas, there is generally one principal cupola in the midst of four smaller ones which surround it, and the small ones are nearly always at the four angles of the Greek cross. In every church, the iconostasis is the principal part, which ought to be a representation of the celestial empire; it is composed of four or five different tiers, four of which are indispensable. Each tier is composed of an unequal number of pictures of saints, painted on tablets or long square surfaces, the place of which is rigorously fixed. On the first tier are the three doors; the middle door (in two foldings) ought to be ornamented with the Annunciation of the Virgin—the Virgin on one of the foldings, and the Angel on the other—accompanied with the heads or emblems of the four evangelists; on the right of the door is the effigy of Christ, on the left that of the Madonna; on the right, after that of Christ, is placed the picture of the saint or of the festival of the church: then come the little doors already mentioned, but they ought only to be single doors; above the little doors is placed, on the left, the Greek cross, on the right the cross of Moses, symbols of the New and the Old Testament. Such are the indispensable arrangements of the first tier. The ground of the whole iconostasis is gilt. On the second tier, in the middle, is Christ on a throne; and on the right is St. John the Baptist; on the left the Madonna (without the child): after that appear, on each side, two archangels and six apostles. On the third tier, in the middle, is seated the Madonna, holding the infant Jesus on her knees; on each side of her are seen the effigies of the prophets. On the fourth tier is placed God the Father, on a throne, with the infant Jesus; on each side the pictures of the patriarchs of the church, Sometimes there is a fifth tier, upon which are seen representations of the history or of the passion of the Saviour. The other parts of the church are ornamented with paintings on a gold ground. The forms of the exterior are very simple; with respect to the upper part of the edifices the adoption is nearly general of the oriental manner of the eleventh and twelfth centuries—namely, the entire rejection of the horizontal line of a cornice, as the crowning of the building for the substitution of arched, or pointedly arched forms—determining the extrados of the vaults. This cylindrical covering is well known in the east, and is even to be seen in Italy at the present day, in the environs of Naples. These extrados are painted in all colours. The Russian churches derive a peculiar aspect from the cupolas which rise above the roof. On beginning to build churches in the eleventh century, the prevalent manner in the east was naturally imitated—that is to say, such cupolas were not employed as are seen, for example, at St. Sophia at Constantinople, or at Venice, but such as are to be met with in the churches of those times in Greece. The form of the cupolas themselves, which are generally placed on an octagonal drum, are extremely various, some having the form of a half globe, others of a flat onion, a bud, or a long pear, &c.

Mr. Hallmann next drew a parallel between the Russian, the original Greek, and the western churches which bear traces of Greek influence. The first Christian temples under Constantine in the east, and even at Rome, were circular or octagonal, and were surmounted by a single dome: afterwards the same disposition we find in the interior of the churches, with few variations, but the exterior assumes the square form, as in the church of Sergius and Bacchus, and St. Sophia at Constantinople. This latter church already evinces in the interior the form of a Greek cross, and may be regarded as the basis of the Russian churches. At the end of the seventh century began the difference of dogmas between the iconoclasts and iconolaters, which ended in the rupture between the churches of the east and the west. From this time, probably, may be dated the custom of not allowing carved images or statues in Greek churches, except statues of angels; wherefore we see *niellos* upon bronze doors of Greek origin, even in Italy, as at Monte St. Angelo, at Canopa in Apulia, and at Amalfi, &c. Another difference, probably one of the consequences of the schism, was the establishing, at each side of the grand altar, a secondary one; not, as in Roman Catholic churches, at the ends of the transept, or in side chapels, but at the extremity of the church, in the same direction as the grand altar. Their place is always indicated by a niche or apsis. In the Russian churches which commenced in the same century, it has been shown that this disposition became typical, and that it is quite conformable to the division and subdivision of the iconostasis. This disposition is to be met with in nearly all the churches of the eleventh, twelfth, and thirteenth centuries, at Bari, Trani, Malfetta, Otranto, &c., where the Greek worship then prevailed. This situation of the altars is seen even where the churches are Roman Catholic, as at Palermo, in the chapel at Martorana and Monreal, and even at Amalfi and Ravello. Considering that this disposition is found in churches of an earlier date, as St. Parenze in Istria, at St. Fosca, &c., and that perhaps even the form of the ancient basilicas might have given rise to this disposition; it may be very possible that the Greeks preserved this form as an ancient custom of the Church, and that it was the Roman Catholics rather who departed from it. This observation is corroborated, if we observe that the ancient writers tell us that there was, on the left of the altar, a place for the deacons of the church, afterwards called the sacristy, and, on the right, an altar for the consecration of the bread and wine for the communion. In Roman Catholic churches, we always see a sacristy at the side of the church, but, in the Greek Church, the priests always robed themselves behind the iconostasis; and, up to the present day, there is an altar at the side of the present one for the preparation of wine and bread. Another very remarkable difference in the Russian churches is the not having separate places for the women, and there is not a single remnant of a tribune or gyneceum—a circumstance the more astonishing as this disposition is met with not only in the East, but also in nearly all the churches on the coasts of the Adriatic Sea, at Bari, &c. The author concluding by passing in review the modern churches erected after Peter the Great, especially at Petersburgh, and by exhibiting and explaining an original design for a Græco-Russian church exquisitely drawn, and embellished with all the attractions of that gorgeous colouring, which is so peculiar a feature in those edifices.

REMARKS ON ARABESQUE DECORATIONS, AND PARTICULARLY THOSE OF THE VATICAN.

Read at the Institute of British Architects, Feb. 3, 1840,

By A. POYNTER, Esq., one of the Secretaries of the Institute.

It is an observation which has been very frequently repeated and very variously expressed, that the proper use to be made of the study of the ancients in their works of art, is not to copy, but to endeavour to think like them. Among the principles which guided them, none is more important, or has exercised a greater influence in bringing ancient art to perfection, than that which has been so well condensed into one line by Pope, that

> "True Art, is Nature to advantage dressed;"

and if we wish to rival the ancients in the productions of what is at once excellent and original, we must like them seek for original types in the works of nature.

That such a course of study would be analogous to the practice by which the ancients themselves attained so high a reach of perfection, we have sufficient proof. Nothing in art can be imagined more conventional than the orders of architecture, and yet Vitruvius endeavours to derive them all from simple principles. Vitruvius sufficiently indicates it to have been a received principle that the most conventional forms—and a more conventional form than the Corinthian capital it would be difficult to point out, were supposed to have been originally suggested by the forms and accidents of nature.

To follow up the subject of these remarks, would open a boundless field of inquiry. I offer them in the present instance merely as prefatory to a few observations on the arabesque style of decoration, illustrated by a short review of the arabesques in the Loggia of the Vatican, of which the engravings are before you. I propose to inquire how far the artists who designed and executed these arabesques have been indebted to the antique, and how far they have modified the hints derived from that source, so as to adopt their compositions to the purposes they are destined to fulfil.

In speaking of these sorts of compositions as arabesques, I of course adopt the term as it is commonly understood, and need not explain that we disregard both the etymology and the meaning of the term in applying it to the paintings and stuccoes of antiquity, which represent not only foliage and fruits, but also beasts of every species, and imaginary creatures combined and interlaced together. These decorations have also acquired the name of grotesque, from the grottoes or underground buildings in which they have been found—a term we have perverted still more from the sense in which the Italians invented it.

It is remarkable, that the only mention Vitruvius makes of this style of decoration is in reprobation of it—but he describes it so accurately, that the passage is worth repeating, if for no other reason. After pointing out and classifying what he considers legitimate objects for painting walls, such as architectural compositions, landscapes, gardens and sea pieces—the figures of the gods, and subjects drawn from mythology, and the poems of Homer. He proceeds thus, "I know not by what caprice it is, that the rules of the ancients—(observe, that Vitruvius looks up to the ancients in his day, that is to say, to the Greeks)—who took truth for the model of their paintings, are no longer followed. Nothing is now painted upon walls but monsters, instead of true and natural objects. Instead of columns we have slender reeds, which support a complication of flimsy stems and leaves twisted into volutes. Temples are supported on candelabra, whence rises, as from a root, foliage on which figures are seated. In another place we have demi-figures issuing from flowers, some with human faces, others with the heads of beasts, all things which are not, never have been, nor ever can be. For my own part, I hold that painting is to be esteemed only so far as it represents the truth. It is not sufficient that objects be well painted—it is also necessary that the design be consonant to reason and in no respect offensive to good sense." Pliny also laments that in his time, gaudy colouring and quaint forms were held in greater estimation than the real beauties of art. But with all deference be it spoken, there is another side to the question, which these great authorities seem to have overlooked. Conventional decorations of this kind were within the reach of thousands to whom paintings in the higher branches of art were inaccessible, and a more general diffusion of taste must have been at once the cause and effect of their universal adoption—how universal, the remains of Pompeii reveal to us. If we examine the ancient arabesques independently of these prejudices, we shall find endless beauty, variety and originality; graceful details combined in consistent and ingenious motives and analogies, and great skill and freedom in the mode of execution. We shall also find reason to doubt whether the introduction of the arabesque style really had the effect of discouraging painting of a higher class, since even at Pompeii, poetical compositions of great merit are frequently combined with the lighter ground work of the general decoration.

However fanciful and capricious the arabesque style may at first sight appear to be, there can be no doubt that it may be treated according to the general fixed principles of art, and that the artist will be more or less successful as he keeps these principles in view. A due balance of the composition is essential, so that the heavier parts may sustain the lighter through every gradation, and there must be such a disposition as not to cover too much or too little of the ground. Unity of design is to be studied in a connexion of the parts with each other, and in the harmony of the details and accessories, which ought as much as possible to tend so some general aim. It would lead us much too far to enter upon the subject of colour—but it may just be observed, that in the ancient decorative painting, the balance of colour is strictly attended to. Their walls usually exhibit a gradation of dark pannels in the lower part—a breadth of the most brilliant colours in the middle and principal division, and a light ground thinly spread with decoration in the upper part and in the ceiling—an arrangement dictated by the natural effects of light and shade, and reflection. As lightness and grace are the peculiar attributes of arabesque, the foliage which forms its most fertile resource should never be overloaded; its details and modes of ramification ought to be drawn from nature. The poems of Schiller and other German authors have lately been published with a profusion of arabesque decoration in the margin, which are well worthy of attention, both for the ingenuity with which they are rendered illustrative of the text, and for the accuracy, the *botanical* accuracy, with which some of the foliage and flowers are represented, and which form one of the greatest charms of these clever and original compositions.

Although the paintings in the Loggia of Vatican pass under the name of Raffaelle, it is not pretended that they are the work of his hand, nor were his designs. He was indeed the originator and director of the whole, and the character and influence of his taste is visibly stamped on every part. But his coadjutors in the work were artists whose names are inferior to none in the Roman school but his own, such as Guolano Romanino, Perino del Vaga, Benvenuto Tisi, and others, who were occupied not only in the execution but the invention of the details. Francesco Penni, and Andrea da Salerno are particularly noticed as being employed for the figures. Giovanni da Udino for the fruits and flowers, and Polidoro Caravaggio for the releivos. It may be worth digressing to mention, that M. Quatremere de Quincy is of opinion that the sculptures of the Parthenon were produced by similar means, Phidias there performing exactly the same part as Raffaelle in the Vatican—and it is indisputable that the combination of unity of design, with variety of detail which characterizes gothic architecture, could have been produced only by the same system, and by employing the minds as well as the hands, of those by whom the decorations were executed. When we see perfection attained in three distinct styles of art, in three distinct ages, by means precisely similar, it is not too much to assume that these means are probably the right ones.

The Loggi ofa Raffaelle, as you will see by the large section which forms one of the permanent ornaments of this room, is an arcade in thirteen compartments. The arches are open, or at least were so originally, toward the court of which the Loggia forms one side. The opposite side, that namely which is represented in the drawing before you, is a wall pierced with windows, one in each arch, giving light to the suite of rooms which contain the great frescoes of the prince of painters. The ceiling of each compartment forms a square cove, on the sides of which are the pannels containing the series of scriptural paintings, the engravings from which are known as Raffaelle's bible. These are his own designs, and some are known to have been touched with his own hand. Both the lateral and cross arches are supported by pilasters about 16 feet high, panelled, and decorated with coloured arabesques on a white ground. It is to these pilasters the present remarks will be confined. Each pilaster on the wall side is flanked by a half pilaster, in which the arabesque is carried through on a smaller scale of composition.

The description of these pilasters will be taken in the order in which Volpato has engraved them, that is to say, beginning on the side next the wall.

I. Notwithstanding the great variety in the composition and details of these works, we shall find a general unity of design pervading throughout, with the exception of the last five of the series, which will be particularly noticed in their turn. Whatever form the composition may take, it is rendered subservient to the introduction of four medallions, or tablets relieved from the back ground in stucco, of contrasted shapes—one like an antique shield—the next circular—the third rectangular—and the fourth spindle-shaped. These medallions occupy the upper part of the pilaster to the extent of about one-third of the whole panel, while the lower part, to the height of the dado, or somewhat higher, is generally filled in such a manner as to afford a *weight of colour*, sufficient to support itself by the side of that member of the architecture, and the marbles introduced into its panels, following in this respect the practice of the ancients. These medallions might appear to violate the due balance of the arabesques if they were identified with them—but the composition is rescued from that fault, by the separate character given to the decoration of the medallions, and by their being detached, and hung as it were, independently upon the back ground. In the general arrangement of the whole, these medallions perform a most important part, connecting the pilasters with the panelled stuccoes adjoining, by their relief, and by means of an accordant style of decoration and a similarity in the subjects represented upon them, neither of which could have been well embodied in the arabesque itself.

It must be admitted that these compositions considered separately are somewhat unequal, and the examples to be first passed in review are by no means the best, but instruction may be derived from a consideration of their defects. The clusters of natural fruit and foliage which surround the windows are continued throughout the series of arches, and are greatly varied in detail, though precisely similar in composition. There is nothing conventional in these festoons—the clusters are simply connected together by a string, and are composed of the most familiar objects rendered with perfect truth. The melon, the orange, the chesnut, the tomata, the olive, grapes of different kinds, pomegranates, gourds of every description, pine and cypress cones are those which most frequently recur, with their foliage and blossoms. The artist has not even disdained the cabbage, cucumber, and the onion. This example may teach us that objects for decoration may be sought throughout the whole range of nature's works with hopes of success.

Unity is again lost sight of in the design No. 18, but the different objects which compose it, are harmonized upon a totally different principle from any which have been hitherto examined, and the effect is rather dependant upon colour than on form. The panels contrast brilliantly with the white back ground, and are relieved and rescued from heaviness by the sharp dark lines which surround them; this is quite antique.

Having now completed the review of this series of arabesques, it is not my intention to detain you by any lengthened observations upon them, such as occurred, having been expressed on the immediate occasions on which they arose. In the resources which the decorative artist can call to his aid, the moderns have greatly the advantage over the ancients, since we possess their materials and our own also. For as long as ancient authors are read, and ancient art appreciated, so long will allusions to the manners, customs, poetry and religion of antiquity be familiar to us, and the symbols to which they gave rise be universally understood; indeed numberless allusions of this kind are constantly before us, and are so familiar, that we forget to inquire their origin. In personification, and the embodying of abstract ideas, the field is as open to us as to them, and we see to what advantage it may be turned by the examples we have just passed in review, and if we add to all these objects, those derived from the useful arts and sciences which may be turned to account in the hands of the skilful decorator, his resources may be considered boundless. For as we have seen in these examples, it is not the familiar aspect of any object which should banish its representation from works of fancy. Every thing depends upon its proper application. The ancients made the best use of whatever they considered most appropriate, and we must endeavour to do the same. Thus on the pedestal of the column in the Place Vendome, which is a professed imitation of that of Trajan, modern arms and habiliments occupy the place of those of the Roman period, sculptured on the original. Whether this translation be as well executed as it might be, is not now the question—I merely notice it as being right in principle. One fertile source we have totally unknown to the ancients, from which materials may be drawn for decoration. Carrying with them the invaluable quality of being in all cases significant as well as ornamental—I mean the science of heraldry—I cannot help thinking that the Greeks who used so much diversity of colour in their architecture, would have availed themselves liberally of the tints of heraldry in their decorations had they been accustomed with it. From the personal allusions it conveys it might be made a much more important feature than it even now is in the decoration of private as well as public buildings, and we have only to study the works of the middle ages for invaluable hints for the work in which it may be applied. The mere display of shields of arms is but one. We shall find heraldry intimately woven into the ornaments of our gothic buildings, and he who can read its language may often understand an allusion in what may appear at first sight a mere decoration. Thus one of the mouldings of the tomb of Humfrey Duke of Glocester, at St. Albans, is filled with an ornament, which on examination resolves itself into a cup containing flowers, a device assumed by that prince, says a MS. in the College of Arms, as a mark of his love for learning. Heraldry has not been neglected in modern Italian art, and I remember in particular a very well imagined arabesque in the Town-hall at Folisno. The ceiling is covered with foliage, spreading from the centre.

In the pilaster No. 3, many of the details are in the true spirit of the antique—the single figures are less so. An ancient painter would not have placed them on a scrap of earth. In the Pompeian decorations, the detached figures—I do not speak of such as are inclosed in frames—but the *detached* figures, partake of the artificial character of the style to which they are adapted, and if they are not represented as floating in the air, they stand upon a bracket, or a mere line, or on any thing but the natural ground.

My objection to some of the terminal figures is, that they are improbable. Improbable I mean upon certain postulates, which it is necessary to assume before we can reason upon these imaginary compositions at all. The mythology of the ancients has peopled the elements with beings compounded of the human and brute creation; their intelligence being indicated by the first, and their fitness for the region they are supposed to inhabit by the second. There is nothing in ancient art in which greater taste or judgement is displayed than in some of these combinations. The animal functions appear in nowise compromised by the mere interchange of corporal members, between different species. Such combinations therefore, as long as they involve no glaring disproportions, present nothing repugnant to the mind, and we are so familiarized to them, that we pronounce upon the success of the representation of a triton, a satyr, or a centaur, with as little hesitation as we might upon that of any of the animals of which they are compounded. We are equally ready, or perhaps owing to a stronger association of ideas, *more* ready to admit of aerial beings, supporting themselves on wings, floating in the ether, or alighting upon a flower without bending the stalk; though these are, in fact, less probable than those born of the ocean or the earth. Between animal and vegetable life there is also a sufficient analogy to attach some probability, or at least to afford an apology, for the graceful combinations between these two kingdoms of nature, invented by the ancients, and adopted to a very great extent in the compositions before us; but, when we come to combine animal life with unorganized matter, the probability ceases, and if, as in the case before us, the unorganized portion is something artificial, and totally out of proportion, besides the combination becomes intolerable. Thus we acquiesce in the metamorphoses of Ovid or the Arabian Nights, as long as certain analogies are observed—but the transformation of the ships of Eneas into sea nymphs, is a violation of probability to which nothing can reconcile us.

No conventional form has been more abused than the terminus; intelligence and immobility are the attributes which the ancients intended it to embody, but their apposite creation is totally different from anomalous composition like this into which it has been tortured.

In No. 5 we arrive at a superior composition, for it must be repealed; we are examining the decoration of a single member of an extensive *whole*, and that, however beautiful each may be, unity is a beauty in addition. No object in decoration has been so extensively used as the scroll. The ancients do not appear to have been afflicted with an unhappy craving for novelties, nor to have been haunted with the apprehension that beautiful forms of composition would become less beautiful by repetition. When the most appropriate forms in architecture and decoration were once ascertained, they were continually repeated, but marked with a fresh character, and stamped with originality by those refined and delicate touches which were all-sufficient when they were properly appreciated. In the same manner with regard to the ever-recurring form of the scroll, as long as the foliage and ramifications of nature are unexhausted, so long will it be capable of assuming an original character in the hands of the skilful artist. A striking illustration of this position may be drawn from the arabesques in the palace of Capsasola, where the pilaster of the Loggia are decorated with scrolls, all similar in composition, but each formed of a different species of natural foliage without the intermixture of any thing conventional except the regularity of the convolutions.

For the magnificent scroll before us we are indebted to the antique; it is an imitation of the well known frieze of the Villa Medici, but the artist has made it his own by the skill with which he has adapted it to his purpose, both in proportion and colour. Nothing can be more happy than the manner in which the upper part grows from the original design. I would particularly call your attention to the animals—the squirrels, the mice, the lizards, the snake, the grasshopper, and the snail, dispersed about the branches, so well calculated to fill the spaces they occupy, and at the same time producing a variety which would have been wanting, had the foliage only been extended with that object. To the scroll in the half pilaster it is to be objected that it is a repetition in small, of that in the principal compartment—but if examined separately, it will be found full of instruction from the union it displays of natural objects with conventional forms. The spiral line of the antique scroll is evidently drawn from the natural course of climbing plants,—it is conventional in its openness and regularity. The involucra of plants furnish the hint for the base from which the antique scroll is made to spring and the spathes of the liliaceous tribe for the sheaths, of a conventional repetition of which, the ancient sculptured scrolls principally consist. Thus far for the general elements of the antique scroll, which the artist has implicitly followed in the example before us; but he has enriched his composition without disturbing its unity, by making every sheath produce a different branch, drawn immediately from nature. The birds present an equal variety, and are occupied according to their natural habits, in feeding on the berries and buds, or on the variety of insects which are also introduced. The arabesques in the side panels are to be particularly noticed in this example. A *motion*, however slight, is always to be desired, and here we see a very graceful one in the two winged boys who dip into a vase-like fountain. The winged bear which occupies the medallion may be noticed as a violation of probability. A being to cleave the air should not be selected from the most heavy and awkward of animals: it is undoubtedly intended for a *jeu d'esprit*, and is quite in the spirit of the antique. The ancient frescoes are full of such whimsical combinations, but always as in the present instance, occupying a subordinate place.

No. 7, is one of the most remarkable of the series. In this the artist has ventured, and with the most perfect success, to discard every thing conventional, and to represent a natural tree, balancing its irregularities of ramification and foliage by the numerous birds which occupy the branches, when they may be supposed to have been collected by the call of the bird-catcher, who is concealed in the underwood with his bird-call in his mouth. One bird, fettered by a limed twig, is about to fall into his hands. It is impossible to admire too much the skill with which this simple *motion* is worked out.

It may be observed in reference to Nos. 4 and 11, that folds of drapery are too broad and heavy to be successful in arabesque—its effect is seldom pleasing. I must also protest against the birds which crown this composition. Nature has provided a variety which makes it quite unnecessary to seek novelty by combining the neck of one species and the tail of another with imaginary wings. The first impression is, that these birds are meant for swans; the second, and abiding one, that the artist did not know how to draw a swan; he has not mended them by dressing them in trowsers.

In No. 15, the artist has chosen the apparently incongruous subject of fish to combine with his foliage. In a painting by Hogarth, we see in the fashionable furniture of one of his scenes, a composition of foliage inhabited by fish instead of birds, although this absurdity be intended as a caricature of the talk of the day, it is no great exaggeration of the fact. In this design, the foliage and the fish are brought together without the slightest violation of probability; the fish have been hung to the branches—the variety of their forms and colours produces an admirable effect, and above all, they are perfect in the condition, more especially indispensable in objects not intrinsically graceful or pleasing, of being represented with the most absolute truth to nature.

INSTITUTION OF CIVIL ENGINEERS.

SESSION 1840.—ANNUAL REPORT.

The Council of the Institution of Civil Engineers, on resigning the trust confided to them by the last annual general meeting, solicit the attention of this meeting, and of all those who are interested in the welfare of the Institution, to the following report on the proceedings and on the state and prospects of the Institution at the close of this the twenty-first year of its existence. At the last annual general meeting, the council of the preceding year had the gratification of congratulating the Institution on its then assembling in its new premises under circumstances which furnished so advantageous a contrast with the condition of earlier years, and such convincing evidence of the steady progress and success which had attended the labours of the Council and the co-operation of the general body. And though the year which is now closing upon you may not have been marked by events of so striking a character as the preceding one, the council nevertheless experience the highest degree of satisfaction in reviewing the proceedings of the session of the year so auspiciously commenced. Aware of the more extensive duties and increased responsibility entailed upon them, the council have endeavoured so to direct the affairs of the Institution as to keep pace with its growing importance; and they can with confidence assert, that the proceedings of the last session have not been inferior in interest or importance to those of any preceding session; whilst the attendance at the meetings, and the anxiety which is evinced by strangers to become acquainted with the proceedings and objects of the Institution, show the estimation in which it is held both at home and abroad, and fully warrant the most sanguine anticipations of its future and continually increasing success.

The attention of the last annual meeting was directed to the expediency of some alteration in the existing laws, particularly with reference to the election of officers and the number of the council. It was suggested that the annual election of the council should be conducted in a somewhat different manner from that hitherto pursued; that a greater number than that constituting the council should be nominated, and that, consequently, each person at the annual general meeting, instead of, according to the then existing practice, erasing one name and substituting another, should erase as many names as the number on the balloting list exceeded the constituted number of the Council. It was also suggested, that it would be for the advantage of the Institution that the council should be increased by the addition of two members: that as some members of the council are frequently prevented by professional engagements from regular attendance, the council should be enlarged to as great an extent as might be consistent with the true interests of the Institution. These and some other suggestions for the better regulation and stability of the Institution, were subsequently submitted to a general meeting of the members, and now constitute part of the bye-laws of the Institution.

The practice of other societies in publishing their transactions in parts, containing such communications as were ready at frequent and short intervals, was briefly touched upon in the last report, and was discussed in considerable detail at the last annual meeting. Such is the nature of some communications, that delay in their publication may be considered not only as a positive injustice to the author, but as detrimental to the cause of practical science, and the best interests of the Institution; and if the publication of such papers be delayed until a whole volume is ready, authors will inevitably avail themselves of other channels for bringing their labours before the world. Add to which, when a whole volume containing many valuable plates is to be published, the sources of delay are numerous, and such as cannot be avoided. The council conceive that the experience of the past year has fully borne out the preceding views, and shown the great importance and value of prompt publication. Early in the session the Institution received a most valuable communication from your member, Mr. Parkes. It was considered desirable that the publication of this communication, forming, as it did, a continuation of his researches already published in the second volume of the transactions, should not be delayed. No other communications being then ready for publication, the council resolved to publish it at once as the first part of the third volume. This has now been for some time in the hands of the public, and the number of copies which have been disposed of shows the great desire evinced to obtain these papers as soon as published. The council have also had still further proof of the importance of this plan. The Institution received, during the last session, several communications well suited for publication in the Transactions, and among them, the continuation and conclusion of that already mentioned by Mr. Parkes. Preparations were made for the immediate publication of these papers in a second part; difficulties and delays which could not have been foreseen or prevented, occurred in the publication of some of them, and thus the second part contains but two instead of the nine communications originally destined for it. The greater portion of the remaining seven papers are already printed and the plates engraved, so that the third part will be in the hands of the Institution in a very short time. There are several other valuable communications in the possession of the Institution now in the course of preparation for publication, and which will appear as soon as circumstances will permit.

The minutes of proceedings have been printed at such short intervals during the session, as the abstracts of papers and minutes of conversation would furnish sufficient materials. The council conceive that great advantages may, and indeed have, resulted from a publication of this nature. An authentic account of the communications is thus immediately furnished, attention is continually kept alive to the subjects which are brought before the Institution, and the statements there recorded have elicited very valuable communications, which otherwise would probably never have been brought forth. No one can turn over the minutes of the last session without remarking the number and the diversity of the facts and opinions there recorded, very many of which were elicited by the statements contained in some written communication, or casually advanced in the course of discussion.

The council cannot omit this opportunity of insisting on the importance of these discussions in promoting the objects which the Instituion has in view. The recording and subsequent publication of these discussions are features peculiar to this Institution, and from which the greatest benefits have resulted and may be expected, so long as the communication of knowledge is solely and steadily kept in view. It would be easy to select many instances during the last and preceding sessions, of some of the most valuable communications to the Institution owing their origin entirely to this source. The first communication from Mr. Parkes arose entirely out of the conversations which took place on the superior evaporation of the Cornish boilers being referred to as one cause of the great amount of the duty done by the Cornish engines. The communication by Mr. Williams on peat and resin fuel owes its origin to his being accidentally present at the discussion on the uses of turf in the manufacture of iron; whilst that by Mr. Apsley Pellatt, on the relative heating powers of coke and coal in melting glass, arose entirely from the discussion of the facts stated by Mr. Parkes respecting the superior evaporation produced by the coke from a given quantity of coal than by the coal itself. And lastly, the extremely interesting and highly valuable discussions at the commencement of last session on the uses and applications of turf; and on the extraordinary coincidence between the results obtained by Mr. Lowe, Mr. Parkes, Mr. Apsley Pellatt, and Marcus Bull, of Philadelphia, experimenting as they did with totally different views, and under totally different circumstances, must be fresh in the recollection of all present.

But, besides the positive advantages which have thus resulted, and may be expected, from a steady adherence to these practices so peculiar to this Institution, there are others of the greatest value to those engaged in practical science. By this freedom of discussion statements and opinions are canvassed, and corrected or confirmed, as soon as promulgated, the labours of authors and claims of individuals are made known and secured as matter of history—and attention is continually kept alive to the state and progress of knowledge in those departments of science which it is the especial object of this Institution to promote. The council trust, therefore, that those individuals who have stored up knowledge and facts for many years past, and devoted themselves to some particular branch of science, will consider how much they have in their power to contribute, and how great is the assistance which they can render to the labourers in other branches, and, above all, to those who are ambitious of following in their steps, by freely communicating, either orally or in writing, the knowledge which they have collected; so that the records of the Institution may be unparalleled for the extent and correctness of the information which they contain.

The council have endeavoured from time to time to direct attention to subjects on which it was conceived communications were needed or desirable, by proposing such subjects as objects for the premiums, placed at the disposal of the council by the munificence of the late president. The communications sent in compliance with this invitation have not been numerous. Two, however,—one by your associate Mr. Jones, on the Westminster Sewage, and the other by Mr. Hood, on Warming and Ventilating,—seemed to call for some special mark of distinction.

The communication by Mr. Jones is of the most elaborate and costly description. (*See Journal*, vol. 2, p. 311). The council conceived that, in awarding to Mr. Jones a Telford medal in silver and 20 guineas for this laborious communication, they were bestowing a suitable mark of approbation on the author of a record which is nearly unparalleled, and must be of great value as a source of information in all future works of this nature, when other, and particularly foreign, cities carry into effect a system of drainage, in which they are at present so deficient.

The council cannot pass from this subject without expressing the obligations which the Institution is under to the chairman and the commissioners of the sewers of the Westminster district. On its being intimated to them that the council wished some account and record of the work over which they preside, permission was immediately given for any person desirous of preparing such account to have free access to all the documents in their possession relating to this subject, and to make such extracts or copies therefrom as could in any way contribute towards this object.

The communication by Mr. Hood contains a detailed account of the principles on which the salubrity of the atmosphere in crowded rooms depends, and the various methods which have been adopted for warming and ventilation. (*See Journal*, vol. 2, p. 469). The importance of ventilation, and the success which has attended the adoption of mechanical means in the manufacturing districts, are subjects worthy the attention of all who study the health of those who, from choice or necessity, are exposed to the generally unwholesome atmosphere of crowded apartments. This subject is of the highest importance to the manufacturing poor of this country, who are compelled to work in crowded rooms at high temperatures. The council are aware that much has been done towards this object in some of the large cotton works of Great Britain, and they hope ere long to obtain some detailed account of the means by which this has been accomplished, and the results which have ensued.

The council have also awarded a Telford medal in silver to your associate, Charles Wye Williams, for his communication on the Properties, Uses, and Manufacture of Turf Coke and Peat Resin Fuel; and to Mr. Edward Woods, for his communication on Locomotive Engines.

The various applications of peat as a fuel had been repeatedly the subject of discussion at the meetings of the Institution, and this communication may (as has been already noticed) be attributed to the discussions then going on. (*See Journal*, vol. 2, p. 145).

The communication by Mr. Edward Woods, published in the second volume of the Transactions, will always bear a prominent place among the records of practical science, as one of the earliest and most accurate details on the actual working of locomotive engines. The first communication was received early in the session of 1838. (*See Journal*, Vol. 1, p. 139.) The author was thought capable of adding so much to his already valuable communication, that the council referred it back to him for this purpose, and it was not received in the form in which it appears in your Transactions till after the premiums for that session were awarded. But this communication (notwithstanding the interval since it was laid before the meeting) will probably be fresh in the recollection of most present, from its giving an accurate account of the progress of the locomotive engines on the Liverpool and Manchester Railway from the opening of that important work. The experience of engineers had at that time furnished them with but little knowledge as to what were the most essential requisites in railway engines, and the advance of knowledge, as shown by the history of the locomotive engine on this railway, is a most interesting and instructive lesson to every one who would study the progress of practical science and improvement. Great alterations were found necessary in the strength of the parts, in the weight of the engines, in the road, and the number of wheels. The first engines were gradually adapted to the necessities of the case, and the arrangements then resorted to as necessary expedients have now been adopted into the regular and uniform practice. Besides the extreme interest of that which may be termed the history of these improvements, the communication is replete with theoretical principles as to the working of locomotives, and the advantages and disadvantages incident to peculiar practical adaptations. It would exceed the limits of this report to do more on the present occasion than briefly to state that this paper contains extended remarks on the relative advantages of four or six wheels, of inside or outside framings, of crank axles or outside crank pins, of coupled or uncoupled engines. The council would point out this paper to the junior members of the profession, as an example of how great a service may be rendered by simply recording what passes under their daily observation and experience.

The council have also adjudged a Telford medal in bronze and books to the value of three guineas to Mr. R. W. Mylne, for his communication on the Well sunk at the reservoir of the New River Company at the Hampstead-road, (*see Journal*, vol. 2, p. 311); to Lieutenant Pollock, for his drawings and description of the Coffer Dam at Westminster Bridge, (*see Journal*, vol. 2, p. 311); and to Mr. Redman, for his drawings and account of Bow Bridge.

Among the other communications of the session, the council cannot, on the present occasion, omit to notice those of your member, Mr. Parkes. His communication on the Evaporation of Water from Steam Boilers, (*see Journal*, vol. 1, p. 170), for which a Telford medal in silver was awarded during the preceding session, and the interesting discussions to which it gave rise, are too well known require further comment. But great as were the benefits conferred on practical science by the facts there recorded, they have been much surpassed by the subsequent labours of this author. In continuation of his subject, you received early in the session the first part of a communication on Steam Boilers, (*see Journal*, vol. 2, p. 225); and at the close of the session, the second part, treating of Steam Engines. Before Mr. Parkes was induced to turn his attention to the preparation of these communications, no attempt had been made to bring together, in one connected view, the various facts which had been ascertained. The economy of the Cornish system was indisputable; but to what it was to be referred was involved in some obscurity. It was reserved for this communication to call attention to certain quantities and relations which exerted a peculiar influence over the results; and which, being rightly ascertained, were at once indicative or exponential of the character of the boiler. If it be found that, in one class of boiler, the same quantity of coal is burnt eight times as rapidly as in another class—that the quantity consumed on each square foot of one grate is twenty-seven times that on the grate of another—that the quantity of water evaporated bears some definite relation to the quantity of heated surface—and that there is twelve times more evaporated by each foot of heated surface in one class of boiler than in another—and finally, that the quantity of water evaporated by a given weight of fuel is in one class double the quantity evaporated in another,—we have arrived at some definite relations whereby to compare boilers of different kinds with each other. To these definite quantities and relations, the author, with apparent propriety, assigns the term "exponents;" and these being compared together for different boilers, their respective merits as evaporative vessels are readily perceived. Mr. Parkes has also called the attention of engineers to the effect of the element time, that is, the period of the detention of the heat about the boiler. The importance of attending to this cannot be too strongly insisted on; as it would appear from these statements, that boilers being compared with each other, in respect of their evaporative economy, are nearly inversely as the rate of combustion. Attention is also called to the fact, that there are actions tending to the destruction of the boiler entirely independent of the temperature of the fire, and which may be designated by the term "intensity of calorific action." Of their nature we know nothing, but the durability of different boilers, under different systems of practice, affords some means of comparing the intensity of these actions.

Mr. Parkes having, in the first part of the subject, thus pointed out the distinctive features of the different classes of boilers as evaporative vessels, proceeds, in his subsequent and concluding communication, to consider the distribution and practical application of the steam in different classes of steam engines. And for this purpose, he is led to consider the best practical measure of the dynamic efficiency of steam—the methods employed to determine the power of engines—the measures of effect—the expenditure of power—the proportion of boilers to engines—the standard measure of duty—the constituent heat of steam—the locomotive engine—the blast and resistance occasioned by it—the momentum of the engine and train, as exhibiting the whole mechanical effort exerted by the steam—the relative expenditure of power for a given effect by fixed and locomotive non-condensing engines. This bare enumeration of the principal matters in the second communication will give some, though a very inadequate, idea of the magnitude of the task undertaken by Mr. Parkes, for the communication is accompanied by elaborate and extensive tables, exhibiting the results of the facts which he has collected and used in the course of his inquiry, and it may confidently be asserted that a more laborious task has rarely been undertaken or accomplished by any one individual than the series of communications thus brought before the Institution.

It will be one of the earliest duties of the succeeding council to consider in what manner the sense of the great benefits conferred on this department of practical science can most appropriately be testified.

The council also received, at the close of last session, from your member, Mr. Leslie, a most valuable communication on the Docks and Harbour of Dundee. This is one of the records on which the Institution sets the highest value, being the detailed account of an executed work of great extent. It is not, in its present form, well adapted for being laid before the meetings; but on its publication, which will take place very shortly, the Institution will have an opportunity of judging of the high value which it possesses.

In acknowledging, with gratitude, the numerous and valuable presents made to the Institution during the past year, the council would call the attention of the members generally to the want still existing in the library of works of reference on general scientific subjects not immediately connected with engineering, and express a hope that such wants may be supplied by that liberality to which the Institution is already so deeply indebted. The collection of models also requires many additions to render it as complete as the council could wish, and it is only by the wants of the Institution being constantly borne in mind by all who are interested in the subject, that such a collection can be formed as shall be worthy of the Society.

Several societies have made an exchange of Transactions with the Institution, and from the Royal Society of Edinburgh, the Philosophical Society of

Manchester, the Royal Irish Society, and the Royal Astronomical Society, sets of Transactions, as complete as could be made up, have been received. The Master-General of the Ordnance, the Lord-Lieutenant of Ireland, and Colonel Colby, continue their liberal presents of the English and Irish Surveys; and Captain Beaufort and the Secretary of the Admiralty have continued the present of the series of Admiralty Charts. The Institution is also indebted to Mr. Vignolles for the Busts of Locke and Dr. Hutton; to Mr. Field, V.P., for a Bust of the late Henry Maudslay; and to Mr. Rivers, for that of Dr. Faraday.

The council would wish to take especial notice of the large collection of works of the late eminent philosopher, Dr. Young, now deposited in your library. For this great acquisition, the Institution is indebted to the kindness and liberality of his brother, Mr. Robert Young, who conceiving most justly that every thing connected with so great a benefactor to practical science must be highly valued by this Institution, has made it the depository of these books from the library of his distinguished relative. The council, in thus publicly recording their sense of the kindness and liberality of Mr. Robert Young, would earnestly press upon others the importance of following so noble an example, and of presenting such works as are at their disposal, and of which the library of the Institution is particularly in need.

It is announced through the medium of the last Annual Report, that the monument of Telford was nearly finished, and that a site had been selected in Westminster Abbey. The council have now the satisfaction of announcing that the monument is fixed in the place destined for it, and they are confident that all who enjoyed the acquaintance, or knew the merits, of the late distinguished president of this Institution, will rejoice that the memory of one so eminent and so highly deserving has met with so proper and just a tribute of respect; whilst all, no less than those by whose liberality the monument was erected, will feel that he has a name which will endure so long as there exists a record of the triumphs of the British engineer.

It would be vain to expect that an annual meeting should ever recur without the council having to lament the removal by death of some who, by their acquirements, or by their associations of friendship, were endeared to the Institution. On the present occasion the council have to lament the death of your members, Mr. David Logan and Mr. Henry Habberley Price, and of your honorary member, Mr. Davies Gilbert. The records of the Institution contain several communications from Mr. Logan, particularly one on the new Graving Dock at Dundee, and Mr. H. H. Price was, when in town, a constant attendant at the meetings, and took a lively interest in the proceedings and success of the Institution. Mr. Davies Gilbert was, by his writings and his influence, a great benefactor of practical science, and the Transactions of the Royal Society, over which he presided for three years, contain several papers of great value to the practical engineer. He took great interest in the introduction of Mr. Watt's improvements in the steam engine into the Cornish mines, and in the controversy betwixt Mr. Watt and Mr. Jonathan Hornblower respecting working steam expansively, the former employing one cylinder only, the latter two cylinders, in the manner afterwards revived by Woolf; the theoretical efficiency of the two methods being identical, but simplicity and mechanical advantage being greatly in favour of the former, as its present universal adoption testifies. Mr. Davies Gilbert introduced into practical mechanics the term "efficiency" as the product of the applied force and of the space through which it acted in contradistinction of the term "duty," as indicative of a similar function of the work performed. His attention was also directed to the theory of suspension bridges, when the plan for making such communication across the Menai was submitted to the commissioners appointed by parliament. It appeared to him that the proposed depth of curvature of the catenary was not sufficient, and his well-known theoretical investigation of this subject was undertaken with the view of ascertaining this fact; and in consequence of these investigations, the interval between the points of support of the chains and the roadway was increased to the height which appeared to him requisite for works of this nature. The labours of this distinguished individual for the promotion of science were unremitting. He was the founder of several societies; he was the discoverer and early patron of the talents of Davy; and while in parliament he laboured most assiduously in the advancement of all the public works. Regret for such a man, exerting the power of his mind so advantageously and through so many years, must always be strong and sincere; but having attained the ordinary limit of human life, he sunk into the grave amidst the respect and esteem of all who knew him, and has left behind him a name which will ever bear a prominent place amidst the names of those whose lives and talents have been devoted to great and noble purposes.

GEOLOGICAL SOCIETY.

On the relative Ages of the Tertiary and Post-Tertiary Deposits of the Basin of the Clyde, by James Smith, Esq., of Jordan Hill.

In former communications Mr. Smith showed that deposits in the basin of the Clyde had been elevated above the level of the sea during very recent geological epochs, and that some of these beds contain testacea which indicate the prevalence, during the period of their accumulation, of a colder climate in Scotland than exists at present. In this paper he confines his remarks to subsequent observations, which afford most satisfactory evidence that these comparatively modern deposits are divisable into two distinct formations, differing in their fauna, and separated by a wide interval of time. In the older of these formations Mr. Smith has found from 10 to 15 per cent. of extinct or unknown species of testacea; but in the newer only such shells as inhabit the British seas. He accordingly places the former among the newest pliocene or pleistocene deposits of Mr. Lyell, and the latter among the post-tertiary series. Both of these accumulations, he, nevertheless, considers to be older than the human period. In the lowest part of the pleistocene formation of the basin of the Clyde, Mr. Smith places the unstratified mass of clay and boulders, locally called "till," and in the upper, which rests upon it, the beds of sand, gravel, and clay, containing marine shells, a portion of which are extinct or unknown. He is of opinion that some of the similar accumulations in the basins of the Forth and the Tay, will probably prove to be of the same age, as well as the elevated terraces of Glenroy, recently shown by Mr. Darwin to be of marine origin. He is also convinced that a very great proportion to the superficial beds of sand, gravel, and clay will be ascertained to be tertiary, although the absence of organic remains must render it difficult to obtain, on all occasions, satisfactory evidence. During the post-tertiary epoch, or while the beds containing only existing testacea were accumulated, changes of level in the basin of the Clyde must have taken place to the amount of forty feet; but during the human period no change appears to have occurred.

The paper concludes with a list of the fossil shells obtained by Mr. Smith, and not found living in the British seas, or of doubtful existence in them. The number of the species is twenty-four—six of which occur in the crag of England, three in the most recent tertiary strata of Sweden, and seven in a living state in the North seas.

On the noxious Gases emitted from the Chalk and overlying Strata in sinking Wells near London, by Dr. Mitchell.

The most abundant deleterious gas in the chalk is the carbonic acid, and it is said to occur in greater quantities in the lower than the upper division of the formation. The distribution of it, however, in that portion of the series is very unequal, it having been found to issue in considerable volumes from one stratum, while from those immediately above and beneath none was emitted. Sulphuretted hydrogen and carburetted hydrogen gases sometimes occur where the chalk is covered with sand, and London clay, as well as in other situations. In making the Thames Tunnel they have been both occasionally given out, and some inconvenience has been experienced by the workmen, but in no instance have the effects been fatal. In the districts where sulphuretted hydrogen gas occurs the discharge increases considerably after long-continued rain, the water forcing it out from the cavities in which it had accumulated. The paper contained several cases of well-diggers having been suffocated from not using proper precautions.

The tables of the Meeting-room and the Library were covered with donations of specimens and books.

WEDNESDAY, NOVEMBER 20.

Four communications were read.

An extract from a letter addressed to Dr. Andrew Smith by Mr. A. G. Bain, dated Graham Town, Cape of Good Hope, Feb. 21st, 1839, announcing the discovery of the skull and piths of the horns of an ox in an alluvial deposit on the banks of the Modder, one of the tributaries of the Orange River, and forty feet below the surface of the ground. The piths measured, in the direction of their curvature, and including the breadth of the os frontis, eleven feet seven inches, but it is calculated that about five inches had been broken off each point. Their circumference at the root was eighteen inches, and the orbits are described as situated immediately under the base of the horn. Other portions of the head, and five molar teeth, were found at the same time.

On the Origin of the Vegetation of our Coal-Fields and Wealdens, by J. T. Barber Beaumont, Esq.

The author of the communication is of opinion, that the plants discovered in the coal measures were not drifted into large estuaries and there sunk, but that they grew where they are found, and that the districts now forming our coal-fields were originally islands. The principal objections advanced in the paper, against the theory of the transportation of the plants by great rivers, are, that such bodies of water would have required for their existence extensive continents, of which there are no traces; that, as the coal strata near Newcastle are 380 yards in thickness, the depth of the estuary must, in that case, have exceeded six times the mean depth of the German Ocean; that the formation surrounding the coal-fields are of marine origin, and bear no traces of having been dry land at the same time the coal and its associated strata were accumulated; and that the freshness of the plants is opposed to the view of their having been drifted from a distance, and sunk in a deep estuary —a process which must have been accompanied by a certain extent of decay in the plants. Mr. Beaumont then briefly proposes the following, as a preferable theory to account for the production of the coal-fields:—He supposes that they were originally swampy islands, on which plants flourished, and in part decayed; that the islands, during the settling of the earth's crust, were submerged, and covered with drifted clay, sand, and shells, which buried the plants; that these accumulations gradually raised the surface of sunken islands till it again became dry land, and adapted for the growth of another series of plants; and that these processes were repeated as often as there are alternations of coal and strata of earthy sediment.

On the Fossil Fishes of the Yorkshire and Lancashire Coal-Fields, by Mr. W. C. Williamson.

Within the last four years the coal measures of these countries have assumed a zoological importance. which previously they were not supposed to possess. In Lancashire icthyolites have been lately found to pervade the whole of the series from the Ardwick limestone to the millstone grit, and in Yorkshire they have also been obtained in great abundance. On comparing the specimens procured at Middleton colliery, near Leeds, with the fossil fishes of Lancashire, the author detected the following as common to both coal-fields, viz.:—*Diplodus gibbosus, Ctenoptychus pectinatus, Megalicthys, Hibbertii, Gyracanthus formosus;* also, remains of apparently species of Holoptychus and Platysomus; but he has obtained some icthyolites in the Yorkshire field which he has not seen in the Lancashire, and he is of opinion that the latter deposits are characterised by the greater prevalence of lepidoid fishes, and the former by sauroid. These remains, except in the case of the Ardwick limestone, always occur in highly bituminous shale, and they are most abundant where it is finely grained, and in general where plants are least numerous. This distinction in the relative abundance of icthyolites and vegetables, Mr. Williamson conceives may throw some additional light upon the circumstances under which the coal formations were accumulated. The fishes are found chiefly in the roof of the coal, rarely in the seam itself, and not often in its floor. Mr. Williamson, in conclusion, makes some remarks on the manner in which icthyolites are associated with the other fossils of the coal measures. At Burdiehouse they occur in the midst of freshwater shells and Cypris; at Coalbrook Dale with marine testacea; in the lower coal measure of Lancashire, not far from the beds containing *Goniatites Listeri*, and *Pecten papyraceus;* higher in the same field, and in Yorkshire, they are associated with freshwater shells; at Middleton with Lingulæ; and at the top of the series in Lancashire and Derbyshire with Mytili and Melaniæ.

A paper on the Geology around the Shores of Waterford Haven, by T. Austin, Esq.

As the object of this communication is to describe topographically the structure of the shores of Waterford Haven, its details do not admit of abridgment. The formation composing the district are mountain limestone, a conglomerate, clay-slate, and trap, the limestone and conglomerate constituting the greater portion of the east side of the Haven, and the conglomerate the opposite.

REVIEWS.

On Steam-Boilers and Steam-Engines. By JOSIAH PARKES. Transactions of the Institution of Civil Engineers, vol 3. London: J. Weale. 1840.

PART II.—ON STEAM-ENGINES, PRINCIPALLY WITH REFERENCE TO THEIR CONSUMPTION OF STEAM AND FUEL.

IN our Number for July last we noticed the part of this investigation, which treated of the qualities of steam-boilers, and of the influence exercised over evaporation by their proportions and practical management. Of that part we considered the only value to consist in the *facts* therein recorded.

In the introduction to this part the author makes the following very sensible observation:

"The generation and application of steam are distinct problems; they require to be separately treated, and their results to be separately stated. It is the economy of steam which constitutes the dynamic perfection of an engine; it is the economy of heat in supplying steam to an engine; which constitutes the evaporative perfection of a boiler; and it is only by distinguishing the effects of each, that the value of any change of practice, in either department, can be correctly ascertained."

Now, although there may be few, if any practical engineers, who would be disposed to doubt the truth of this remark, yet we are persuaded that it is not in general duly appreciated, or at least, that very little attention is paid to it by them.

The author has divided this part into two portions: in the first, which occupies about one-fourth of the whole, he has investigated the atmospheric, the stationary non-condensing, or the high-pressure, the low-pressure condensing, and the Cornish high-pressure expansive pumping engines. The facts established on these four varieties are collected and exhibited in a comprehensive table, (table 6.) The last three-fourths of the work are dedicated solely to the locomotive engine, the chief part tending to prove the inaccuracy of all the estimations which have hitherto been made of the several resistances which have to be overcome by that variety of engine. The author has, however, also developed a *new theory of the locomotive engine*, the fallacy of which will be at once evident to the scientific reader; but its plausibility might induce the practical man (who has not the means of detecting theoretical errors,) to put implicit faith in its correctness. For his sake, therefore, we shall feel it necessary to take more notice of this new theory than we should otherwise have done.

The two sections in which the author treats *of the methods employed to determine the power of engines*, and *of the measures of effect*, present nothing worthy of notice; but in the next section, which treats *of the expenditure of power*, we have to point out an error, which we thought to be already so thoroughly eradicated, that it could never more find its way into any work having the slightest pretensions to science. This section commences thus:

"The ponderable element of steam is water; its consumption by an engine is appreciable; and it is now assumed, almost universally, that the sum of its imponderable element, heat, is a constant quantity, in steam of all specific gravities. The elastic force of steam is also generally assumed to be proportional to its density; thus, equal amounts of heat and water are expended in the generation of equal power, at whatever pressure steam be used by an engine."

We admit the first assumption, that the quantity of heat contained in a given weight of steam is a constant quantity, whatever may be its density; but it is not a fact, as Mr. Parkes assests, that the elastic force of steam is also generally assumed to be proportional to its density: indeed a comparison of the numbers given in the table, (page 122,) which he himself took from M. de Pambour's *New Theory of the Steam Engine*, would have convinced him at once that that assertion was not well founded. For we there find the volume of steam formed from a volume of water equal to unity is equal to 2427, when generated under a pressure of 10lbs. on the square inch; and 677, when generated under a pressure of 40lb. We ought, therefore, to have, since these volume are inversely proportional to the density of the steam,

$$10 : 40 :: 677 : 2427,$$

which would give, by making the product of the means equal to that of the extremes,

$$24270 = 27080,$$

which is absurd. The conclusion drawn from this law is therefore also false; wherefore equal amounts of heat and water are *not* expended in the generation of equal power, when the steam is used at different pressures.

In this same section, (page 55,) the author tells us that

"By knowing the evaporation from the boilers, and consequently, the weight of water as steam which passes through an engine, we grasp the principal fact of practical consequence to the engineer; a fact which is free from all uncertainty in its nature; . . . . . . and the weight of water, which has passed from the boiler in that state, and produced a given effect, appeals conclusively to the understanding as indicative, in a comparison of engines, of their respective economy in the expenditure of power."

This does not seem very consistent with what he says on the subject in the first section, (page 52,) where, speaking of this method of determining the power of engines, he observes, that "as its value depends on a perfect accordance between the results of experimental and practical science—an accordance yet unascertained,—and since many precautions are requisite to secure true results from this test, it has been seldom resorted to by practical men."

The discordance between these two quotations is most remarkable, and the paragraph which follows the latter leaves no room to doubt that the basis of the method there alluded to is the identical fact which he says is *free from all uncertainty in its nature*, &c.

In the table already alluded to, (table 6,) will be found many results computed from the data furnished by experiment, which, if correct, will be of great practical utility to the engineer. Among these may be mentioned the weight of water as steam equivalent to the production of a horse power in each engine, and also, the duty effected by one pound of steam. "These sums, (columns 11 and 16,") the author observes denote the positive and relative *efficiency of steam* in the different "engines;" and here we recognize the pen of Mr. Parkes in the signification he gives to the word *relative*, it being here used to express the *inverse* of positive. Thus the *relative* efficiency of the steam *decreases* in precisely the same ratio as its *positive* efficiency *increases*, which we find difficult to comprehend with our preconceived notions of the meaning of the word *relative*. We should have thought, for instance, that if the *positive* efficiency of the steam in a given engine were equal to a, and in a second engine to b, its *relative* efficiency in the first in comparison with the second would be $\frac{a}{b}$, and that if, the positive efficiency b, remaining the same, that if the engine were increased from a to $2\,a$, its *relative* efficiency would also, be increased from $\frac{a}{b}$ to $\frac{2a}{b}$, or in the same ratio as its *positive* efficiency, The true *relative efficiency* both of the steam and of the fuel is however, given in columns 21 and 22, under the head *Comparative economical results*.

The next section, which treats *of the proportion of boilers to engines*, in our opinion serves rather to confuse and perplex the reader, and to deprive him of confidence in the numbers set down in the table, than to render him any assistance in drawing practical conclusions from them. We had intended to make a few observations on particular parts of this section; but having vainly endeavoured to follow the intricate reasoning of the second phragraph, and finding nothing of any importance in the rest, we shall merely direct attention to column 20, which will appear on the slightest examination to throw no light whatever on the economical qualities of either boilers or engines.

In the *observations on the experiments and their results*, which follow this section, there is nothing worthy of notice before the 61st page, from which we quote the following paragraph, in order to shew how necessary it is to sift *with the utmost care* all the results tabulated in this work.

> "It is necessary, also, to guard against conclusions which might be deduced, from a comparison of the effects of the Cornish engines in the table, with the pressures on the piston and degrees of expansion, set down in columns 5 and 6. The pressures given were not ascertained by any instrument, (excepting at Huel Towan,) and must be considered only as estimations, not as facts. The pressure upon the piston during the interval which occurs between the first admission of steam into the cylinder, and the instant of shutting it off, may be very variable; that it was so, in several engines to which Mr. Henwood applied the indicator, is evident from the diagrams he has given, annexed to his paper. (Trans. Inst. C. E. Vol. II.) At the Huel Towan engine, when the steam in the boilers was at a pressure of 47·1 lbs. above the atmosphere, it varied from 12·3 lbs. to 7·3 lbs. per square inch on the piston, during its admission into the cylinder; which latter was its elastic force, at the instant of closing the steam-valve. I adduce these facts, with the view of showing the impossibility of determining the precise amount of prssure on the piston, from the degree of *wire-drawing* the steam; and as a caution against expectations of deducing any valid theory of the action of the steam, in these Cornish engines, from the particulars of pressure and expansion, contained in the table, which are only approximations to the truth."

Mr. Parkes does not seem to have compared the numbers contained columns 6 and 14, otherwise he never could have considered the above caution necessary; for the anomalies which would be found to result from the adoption of the numbers there set down are so striking that it would soon be discovered that either the pressure of steam on the piston, or the consumption of water as steam is incorrectly given; and it would certainly not occur to any one to deduce any theory of the action of the steam from such conflicting data. A superficial examination of experiments 7 and 9 will give an idea of the confidence which can be placed in the numbers contained in the table.

The diameters of the cylinders of these two engines are equal, but the latter has four inches greater length of stroke; the steam is also admitted into the cylinder of the latter during one-fourth of the stroke, while in the former it is cut off at one-fifth; but, since the latter only makes 4·29 strokes per minute, while the former makes 5·35, the volume of steam consumed in an hour should have been about equal in the two experiments. Now the pressure of the steam before the expansion is given as 7·3 lbs. per square inch in the former case, and 27 lbs. in the latter case, above the atmosphere, and the volume of steam generated from a given volume of water under these two pressures is respectively proportioned to the numbers 1173 and 653; the consumption of water as steam must therefore be nearly inversely as these two numbers, and taking the consumption per hour in the former experiment at 2156·21 lbs., as in the table, the consumption in the latter experiment ought to be about 3873·25 lbs., whereas it is given in the table as only 972·62, or very little more than one-fourth part of what it ought to be. We conclude from this that the numbers set down in column 6 are of no value whatever, as they do not appear to represent the true pressure on the pistons: nor indeed is it probable that the steam should lose so much as 42 lbs. of its pressure in passing from the boiler to the cylinder, as in the case of the Huel Towan engine, experiment 7. (See columns 6 and 7.) If *wire-drawing* is really carried to such an extent in the Cornish engines, it is a proof of sad mismanagement; for, if it is necessary to throttle the steam to such a degree, in order to reduce it to the desired pressure in the cylinder, it is very evident that the load on the safety-valve might be diminished, and the steam thus generated at a lower temperature, the advantages of which are too obvious to need pointing out here.

Mr. Parkes does not seem very confident of the advantage of the Cornish (expansive) system of using steam in manufacturing engines requiring uniformity of motion, and seems to approve of the method recommended by Mr. Wicksteed in such cases,—(see the Journal for January,) namely to employ a Cornish engine to raise water up on a wheel, and thus transfer its power to machinery. Now, although the momentum of such machinery is but trifling, an equivalent is easily found in a fly-wheel, and the want of uniformity in the action of the steam is probably not so great as may be supposed.

We agree with the author that the *pound of water as steam* consumed by an engine is the most convenient and correct standard of duty which can be adopted, provided we know the true quantity of water which passes through the engine in the form of steam.

The first division of this work is concluded with a chapter *on the Constituent Heat of Steam*, in which the author describes a series of experiments made by himself, the results of which confirm the already generally admitted law, that equal weights of water absorb equal quantities of heat in passing from the liquid to the elastic form, under all pressures.

The remaining portion of this work, which treats *of the Locomotive Engine*, being very long and perplexing, we have not sufficient leisure to enter into a detailed examination of all the difficulties and doubts, opinions and arguments contained in it; we must, therefore, content ourselves with a few general remarks.

The greater part is occupied by an examination of the experiments of M. de Pambour, Mr. Robert Stephenson, Mr. Nicholas Wood, and Dr. Lardner; the object of this examinution being apparently to convince the reader of the inaccuracy of *some of the results* of experiment, and of *all the deductions* hitherto drawn from them, and to prepare him for the reception of a *new theory* of his own, which he lays down in a separate section near the end of the work.

It is very certain that the experiments hitherto made on locomotives are too few in number, and too imperfect in their nature to allow of any certain theory of their action being as yet deduced from them; but on the other hand we have no doubt that a careful investigation of Mr. Parkes' objections would bring many fallacies to light, which might otherwise have the effect of unjustly shaking our confidence in the results previously obtained and published by other authors. As an instance we shall merely cite the comparison he has instituted between two of M. de Pambour's experiments, (pages 95 and following,) which were made with the same engine (Atlas) at two different speeds, and with corresponding loads. Mr. Parkes, in his detailed calculation of the effects produced in these two cases, omits, without assigning any reason for so doing, to include the pressure on the back of the piston, which is undoubtedly a part of the resistance, and therefore the power expended in moving this resistance at the velocity of the piston, is a part of the gross power of the engine, or of the total effect of the steam. With this omission Mr. Parkes finds the absolute (or gross) power of the steam equal to 67·11 horse power in the first case, where the velocity was 20·34 miles an hour, and 59·50 in the second, where the velocity was 27·09, (See page 95.)

In these two experiments M. de Pambour gives the same effective evaporation, namely, ·77 of a cubic foot of water per minute; and it is to prove the impossibility of this fact that Mr. Parkes made the above comparison; for he observes (page 99); "To be consistent, however, with his own (M. de Pambour's) rule above quoted, viz. that 'the weights of water consumed as steam are to each other as the resistances against the piston,' it is obvious that 'if, in the first case, 3026 lbs. of steam passed through the cylinders in an hour, 2166 lb. only would have been expended in the second case." Now this assertion is not even justified by his own calculations, for M. de Pambour evidently did not, nor could he mean to say that the weight of steam which passes through the cylinder in a given time is proportional to the resistance, whatever may be the speed of the engine, which would obviously be absurd, but that the density of the steam, and therefore the weight which passes through the cylinder in a given number of strokes, or which is the same thing, in travelling over a given distance, is proportional to the resistance. The consumption of water in a given time would thus be directly as the product of the resistance by the velocity, or the gross power of the engine; so that, if this power is equal in the two cases, so ought also the evaporation per minute.

The effect of the steam in overcoming the resistance of the atmosphere on the opposite side of the piston is equal to 25·25 horse power in the first case, and to 36·77 in the second, which, added to 67·11 and 59·50, found by Mr. Parkes, respectively give 92·36 and 96·27 horse power as the gross effect of the steam in the two cases. The near coincidence of these two numbers shews that in this case at least there is no validity in Mr. Parkes' objections. We should therefore recommend a most diligent and patient examination of this section, before the adoption of any opinion therein expressed, or the rejection of any others previously entertained,

We have already alluded to a *new theory of the locomotive engine* proposed by the author of this work: the section in which he explains this theory commences (page 124) thus:

“ OF MOMENTUM AS A MEASURE OF THE EFFECT OF LOCOMOTIVE ENGINES.

“ The effective power of a locomotive engine—by which is meant the excess of power after overcoming its proper friction, and the resistance from the blast—is solely expended in the generation of momentum. The momentum communicated to the entire mass set in motion represents the useful mechanical effort exerted by the steam; this effect of the engine is, therefore, at all times determinable; for, being the simple product of the mass moved, multiplied into its velocity, it is the product of two quantities easily ascestained under all the practical circumstances of railway traffic. The consumption of power, as water in the shape of steam, is a third quantity also readily appreciable.

“ Were it possible to work a locomotive engine and its train *in vacuo*, on a truly level plane, the momentum generated by an equal expenditure of power would be a constant quantity at all velocities; for, the resistance being invariable, equal momenta would be produced by an equal expenditure of power with all loads, as the velocity attained would be in the inverse ratio of the loads, and vice versâ. This hypothetical case supposes friction and resistance of all kinds to be constant.”

This is not only a *new theory* of the locomotive engine, but one which involves a *new definition* of the word *momentum;* for, according to the present acceptation of the term, momentum can only be *generated* during an acceleration of the moving mass, which accelleration is not, and ought not to be considered in locomotives, unless the time in which a given accession of velocity is also taken into account at the same time, which is evidently not contemplated by Mr Parkes. What is here understood by the *momentum generated* in one second, is nothing but the *absolute momentum* referred to the second, as the unity of time, which is deduced from the *uniform velocity* of the engine, without reference to the time in which it acquired that velocity.

Since the resistance does not enter into this expression of the power of the engine, it would follow that the same engine would draw the same train at the same velocity, whatever the nature of the road may be; since the evaporation being the same, the power expended must be the same; and since the mass moved is the same, so must also its velocity, to make its momentum equal. The absurdity of this doctrine is obvious.

The next section contains some good observations on *the blast,* as well as some experiments made by the author on *the resistance produced by it;* but no reliance can be placed in the results there recorded, some of them being evidently impossible. At page 147 we read the following:

“ The immediate cause of my entering on these experiments is worth mentioning. I one day observed the mechanic in care of the machine, whilst preparing for work, opening and shutting the grease cocks of a cylinder, and giving oil to a piston. The engines were then working without load, and it was evident that a small vacuum existed after the blast, or the oil would have been blown back instead of entering the cylinder. This fact, the possibility of which had not before struck me, induced me forthwith to order another gauge from Mr. Adie, which was fixed on one of the blast-pipes, in a convenient place for constant observation, about 2½ feet from its junction with the cylinder, the bulb being exposed to the full current of the escaping steam. This instrument detected the fact of a vacuum by marking, usually, a temperature of from 208° to 210°, or about 1 lb. per square inch below the atmospheric pressure, the active steam on the piston being 1½ lb. above it. When the engine was driven at double velocity, or, at 120 revolutions per minute, at which speed it required about 3½ lbs. of steam, the thermometer rose to 211°, and when locomotion was given to the machine at the usual velocity of 60 revolutions of the crank shaft, and requiring 4 lbs. in the boiler, the blast thermometer stood at 212°, exhibiting a pressure equal to the atmosphere only. At 8 lbs. on the piston, a counter pressure of about 2 lbs. was exhibited, at 15 lbs., about 4 lbs., and at 20 lbs. the blast thermometer indicated 6 lbs., beyond which point I was unable to load the engines.”

In his observations on M. de Pambour's experiments (page 87), Mr. Parkes justly remarked that a *vacuum* on the opposite side of the piston was *an impossible result,* and this remark evidently holds good for his own experiments as well as his deduction from those of M. de Pambour.

In conclusion, we would again caution our readers against adopting the conclusions arrived at by by Mr. Parkes without first submitting the whole of his work to the strictest scrutiny. There is some, and there may be much good in it; but, having detected errors of importance in some parts, we cannot depend on the correctness of that which we have not had time to inquire into.

Very great merit is however due to Mr. Parkes for the indefatigable zeal he has exhibited in the compilation of data, and in the comparison of results therefrom deduced, which must have cost him much time and labour, with the praiseworthy object of advancing our yet imperfect knowledge of the effects and comparative economy of steam engines.

The Royal Lodges in Windsor Great Park, *from Drawings by* H. B. Ziegler, *executed by* L. Haghe, *in lithography, by express command, for Her Gracious Majesty Queen Victoria.* Folio. Ackermann.

If by “ express command” we are to understand more than a mere permission, all we can say is that we cannot possibly compliment “ Her Gracious Majesty” upon her taste, for while considered as drawings, the plates are far from rivalling preceding specimens of lithography, as architectural subjects they are very much more unsatisfactory. Indeed it seems to have been taken for granted that the less that was said about these buildings the better, there being no description or information of any sort attached to the plates; therefore, not happening to be acquainted with their history, we are unable to say who was the perpetrator of these Cockney whims and monstrosities—tasteless jumbles of cottage, castle, and what not, without a single redeeming merit of any kind, downright paltriness, and utter want of feeling for any one of the styles thus attempted, being their chief characteristics.

Scarcely can we bring ourselves to believe that Sir Jeffry Wyatville was concerned in the erection of this architectural trumpery; and if not, he would do well to clear himself from a suspicion which is very likely to attach itself to him, as the Royal architect at Windsor. Let the designs have been by whomever they may, they ought never to have been executed; and it fills us with concern to behold—emanating from what ought to be the fountain head of taste, such specimens of it as would be excusable only in some suburban tea-garden. But for their feebleness they might pass for arrant caricatures.

Arboretum et Fruticetum Britannicum; or, the Trees and Shrubs of England. By J. C. Loudon, F.L. and H.S., &c. London: Longman and Co., 1839, 8 vols. 8vo.

The name of Mr. Loudon suggests the idea of a work of great extent, of great labour and research, but that now before us surpasses any of his previous triumphs. It bears less the impress of an individual production than of a national work, a character sustained by the number and value of its contributors, and by the eagerness with which all ranks devoted themselves to the promotion of a task so noble. The man of science hastened to contribute from his stores of knowledge, the grandee and the gentleman threw open their rich collections, or volunteered at their own expence to obtain illustrations for the work. From the duke downwards every patron and amateur of horticultural science seems to have considered co-operation in the work a duty and a pleasure. This detracts not from the value of Mr. Loudon's labours, it enhances them, and is a high proof of the estimation in which they are held.

This work, as it professes, gives a pictorial and botanical delineation, and scientific and popular description of the native and foreign, hardy and half-hardy trees and shrubs of England, with their propagation, culture and management, and their application in landscape gardening. To the landscape artist trees have the same importance as details of style have to the architect, and every artist and amateur is, consequently under an obligation to possess himself of this encyclopædia of the art. The letter-press in the old times might legitimately have been spun out to twenty volumes; the engravings our fathers could never have compassed, they are two thousand five hundred in number, and are executed from drawings by the Sowerbys, and other botanists of distinction. We have only one fault to find with the work, and that is, that we see it disfigured with a barbarous Latin name.

To give extracts from these volumes would be indeed to realize the old Greek apophthegm of showing a brick for a house, so that we must content ourselves with expressing our feeling of the value of Mr. Loudon's labours, and with recommending this admirable work to all who wish to follow with success an art so grand, as that of landscape gardening.

Elementary Principles of Carpentry, illustrated by 50 *engravings and several wood-cuts.* By Thomas Tredgold. Third edition, with an Appendix, by Peter Barlow, F.R.S. London: John Weale, 1840.

This is a new and improved edition of Tredgold's work, and Mr. Barlow bases his chief claim for its value as much on the proper retention of the original matter, as on the excellent additions which he has appended to it. These accessions are so important as to make the new edition desirable even to those who possess the work in its original form. Among many excellent specimens of Foreign and English roofing now introduced from the highest sources, may be particularly mentioned the information given relative to that admirable work King's College Chapel, drawn by Mackenzie, and St. Dunstan's Church, Fleet-street, by Shaw. The drawings of the iron roofs executed by the Butterley Iron Works Company are no less interesting, as well as those of several new buildings in London. We do not, however, so much admire the roof of the Exchange at Genoa, it strikes us as showing more ingenuity than science. We shall probably notice this work more at large next month.

An Essay on the Formation of Harbours of Refuge and the Improvement of the Navigation of Rivers, by the adoption of Moored Floating Constructions as Breakwaters. By John White, Architect, London.

Mr. White has long been an advocate for the application of floating breakwaters, and we think that he appeals successfully to his readers, considering that their own experience on any common river must have convinced them of the efficacy of such a mode of protection. With the application of Mitchell's Mooring Screw and the new Wire Cable, we see no difficulty in carrying out Mr. White's plans both efficiently and successfully.

We feel indebted to the author for the tribute he has paid to our exertions and those of our correspondents, in promoting such an important branch of engineering as harbour construction, but no feeling arising from this tribute, influences us in the expression of our sentiments of the high value of this work.

THE RIVER BOURN, OR INTERMITTING SPRING OF THE NORTH DOWNS.

The bursting or breaking out of the Bourn water about two months since excited some attention at the time, on account of the interval elapsed since its last eruption in the early part of 1837, being shorter than usual, but now (Feb. 16,) that the waters have continued to flow with increased volume, and having flooded the valley through which it passes, together with the lower part of Croydon, called the Old Town, and the turnpike road, it has become a serious inconvenience. This intermitting spring is situated in the great chalk range which stretches in an east and west direction through the south-east of England, called the North Downs, in distinction from the parallel chalk range near Lewes and Brighton, called the South Downs. A traveller taking the high road from London through Croydon to East Grinsted and Lewes, would pass along the valley through which the Bourn water runs. A little to the south of Croydon, the chalk rises from beneath the London and plastic clay formations (its dip being northwards), and with comparatively slight undulations, it attains the height of 800 feet above high water level, within a distance of eight miles to the south of Croydon, the summit being 667 feet above that town.

The first appearance of the Bourn water is in a flat part of the above valley, just below Birch wood house, and is situated between the Half Moon Inn at Catterham Bottom, and the Inner entrance to Marden Park, where it bubbles through the surface of the ground in an almost infinite number of jets, some of them are extremely small, and none more than a quarter of an inch diameter; about twenty yards from the highest of these jets their number is sufficient to form a rivulet, and in 100 yards a very considerable stream, and where it reaches Catterham Bottom, about three quarters of a mile, it may be called a river; the height of the first outburst is 350 feet above high water, from thence it flows northward to Croydon, where it is 133 feet above the same level, therefore its descent from the source to Croydon, is 217 feet in a distance of six miles, or an average of 36 feet per mile, consequently its current is very rapid. Its present eruption has been much greater than any that can be remembered by the oldest inhabitants of the district. The writer witnessed that in 1837, it was confined to the channel which from time immemorial was prepared for it, and which at Riddlesdown (about half way between its source and Croydon,) is about 6 feet wide and 5 feet deep, commonly called the dry river, from its being free from water so long; in the present instance the water has exceeded these limits, and covered the whole of the valley in many places three and four feet deep, and where it crosses Smithern bottom, it has stopped the works of the Brighton railway, that being the point where a deviation of the present Godstone road is to be made, and a bridge erected to carry the railway over the deviated road; the materials for the bridge are all upon the ground, and the embankment, which is to reach to the bridge, is brought nearly as far as it can with propriety before its erection, consequently, these works are stopped till the Bourn ceases to flow.

The cause of this curious phenomenon is, no doubt, the same as described in philosophical works under the head of intermitting or reciprocating springs, from which it appears that the water which falls upon the surface of the ground, percolates through the various strata, until it is stopped by one which is impervious, or it falls into cavities where it is collected as in a reservoir; this continues until the waters have accumulated to the filling of the reservoir, when it finds an outlet in the form of a syphon, consequently, it will continue to flow till the reservoir is empty. It would therefore appear that the short interval since the last eruption of the Bourn, has been occasioned by the almost unprecedented quantity of rain which has continued to fall for many months past.

* Connected with this subject, there is a mine about three miles to the south of the source of the Bourn, in which water began to collect last autumn, and the miners were driven thereby from several of their headings in September last, and it appears that such circumstance always precedes the bursting of the Bourne, and the workmen confidently predict that event.

The works in the Merstham tunnel on the Brighton railway, which is being made through the same chalk range, and scarcely four miles west of the Bourn, have been much retarded, and now nearly suspended, by the quantity of water which has come in upon them; what few men are able to reach their works, are at the present time floated upon rafts from the shafts to the top headings, which alone they are able to drive; previous to this outburst, the tunnel was perfectly dry, and it may therefore be attributed to the same cause as the Bourn water itself.

PROGRESS OF RAILWAYS.

Greenwich Railway.—Thursday morning, 30th January, at half-past ten o'clock, a serious accident, and one that might have been attended with the most fatal results, occurred on the Greenwich Railway. Two Greenwich trains were coming up to town,—the first being the ordinary passenger train, the second one engaged to bring up a detachment of the Royal Artillery to the Tower. A Croydon train was coming at the same time from London, but before it could turn off to take the line that branches off to Croydon, it came into collision with the Greenwich passenger train, and the train with the artillerymen coming up almost immediately, the three trains got jammed together. The Greenwich train was thrown off the line, and several of the passengers injured, but none fatally. Major Boyce, of the Artillery, was severely cut about the head and face, as was a gentleman belonging to the Admiralty.—*Morning Post.*

Great Western Railway.—It is understood a single line of rails on the Great Western Railway from Reading to Twyford will be opened as soon as possible, so that the traffic by single trains should commence at a very early period. To accomplish this end, the works are proceeding day and night whenever the weather permits, but the rain has been a frequent impediment to the workmen.—*Wiltshire Independent.*

Manchester and Leeds Railway.—The Directors have just made their monthly inspection of the works, which are progressing most rapidly. Some idea of the exertions used to push forward the undertaking, may be formed from the fact that Mr. John Stephenson, the contractor for the great tunnel, which is far advanced towards completion, has now in full operation, on that contract alone, 1,253 men, 54 horses, and 14 steam-engines; and that the daily consumption of bricks is from 51,000 to 60,000.—*Railway Times.*

Progress of the North Midland Railway.—A considerable portion of this railway is so far completed as to allow of the permanent way being laid; this is done on the greater part of the line. The most forward district is that situated between Derby and Barnsley. One line of rails is now nearly all laid for the whole distance, which is about 50 miles; great exertions having been made to accomplish this, as it is expected the directors will pass along the line with a locomotive engine, between the towns of Derby and Barnsley, very shortly—probably next week. In the neighbourhood of Belper, Clay Cross, Staveley, &c., the works are proceeding night and day, in order to have a road through the large excavations in those districts. The first class stations are nearly all contracted for, and several of them are in a forward state. The Eckington one is nearly ready for the roof; the Chesterfield and Southwingfield stations are also far advanced; the Leeds and Sheffield stations have been set out during the week. The latter one is contracted for by Mr. Crawshaw, and will be situated near the entrance of the Sheffield and Rotherham Railway. It will be a large and convenient station; the cost is estimated at about 8000*l.* —*Sheffield Iris.*

South Western Railway.—A completely new town is in the course of formation between the old corporation of Kingston-upon-Thames (Surrey) and the South Western Railway, and already nearly two hundred beautiful houses, snug and aristocratic villas are finished, or in the course of finishing. From an inspection of the plans, and a view of what has been done, great taste and judgment appear to be exhibited; and the railway Company, from the advantages of its site over that of the old Kingston station, have been induced to remove it to the entrance to the new town, where a very commodious structure has been erected for the accommodation of the public. It is a singular fact, and one which must mainly contribute to the eligibility of New Kingston, that the first-floor windows of the houses command a view scarcely to be equalled in England, comprising no less than five Royal Parks—those of Hampton, Bushy, Richmond, Windsor, and Claremont, besides the gardens of Kew and the river Thames; and yet this spot, by railroad conveyance is only twenty minutes ride.—*Observer.*

STEAM NAVIGATION.

Launch of an Iron War Steamer.—On Thursday, February 6th, was launched from Messrs. Ditchburn and Mare's building yard, Blackwall, the *Proserpine*, wrought-iron steam vessel of 470 tons. She has four sliding keels, nine water-tight bulkheads, two of which are longitudinal running the entire length of the engine room—is armed with four long guns on non-recoil carriages, and will not exceed four feet draught of water when fully equipt for sea. The engines are two 45 horse, having the wheels to disconnect on a new and improved method to facilitate sailing, by Messrs. Maudsley, Son and Field. This vessel is constructed for sailing as well as steaming. It is a fact worthy of record, and ought to be generally known, that Messrs. Ditchburn and Mare were the first who arrived at the hitherto deemed unattainable result of giving highly superior sailing qualities to iron sea-going vessels of shallow draught of water. Their application and improvement of *sliding* *keels* have been most successful, their simplicity is such that a boy can manage them. Every person conversant with the history of naval architecture is aware that Captain Shanks, R.N. was the ingenious inventor, and that he received his first idea of them from the Indian navigating his raft, but although Captain Shanks, aided by the government of his day, made several attempts to establish their use in timber-built vessels failed, chiefly in consequence of the great difficulty in making the well and aperture through the keel, through which the sliding keel works, permanently water-tight; this in an iron vessel can be most perfectly accomplished. They are of the highest utility in the prevention of lee-way, counteracting rolling motion, and the vessel can be steered by them without the help of the rudder!

Testing the strength of Iron Boats.—On Monday, February 24th as they were lifting from the wharf a 25 horse boiler of an iron boat, built by Ditchburn and Mare, the crane which was of cast-iron broke, when the boiler and crane fell a distance of 8 feet into the bottom of the vessel, little or no damage was done, and fortunately no one was hurt. This vessel is named the *Lee*, and has the reefing wheels after Mr. Hall's patent, we believe this to be the first application of them—we wish them every success.

The *Orwell* iron steamer, plying between London and Ipswich, made during the late gales several passages from London to Ipswich in seven hours, including the calling off Gravesend, at Harwich, and other stoppages, a distance of 112 miles.

The Sons of the Thames, of which vessel we made mention in our January Journal, came from Gravesend Pier to Blackwall in one hour and five minutes, a distance of 20 miles.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM 30TH JANUARY, TO 26TH FEBRUARY, 1840.

Moses Poole, of Lincoln's Inn, Gentleman, for "*improvements in pumps for raising and forcing water and other fluids.*" Communicated by a foreigner residing abroad.—Sealed January 30; six months for enrolment.

William Brochedon, of Queen's Square, Middlesex, Esq., for "*improvements in the means of retaining fluids in bottles, decanters, and other vessels.*" January 31; six months.

Philippe Marie Moindron, of Bedford Place, Russell Square, Merchant, for "*improvements in the construction of furnaces and in boilers.*" Communicated by a foreigner residing abroad.—January 31; six months.

William Cubitt, of Gray's Inn Road, Builder, for "*an improvement or improvements in roofing.*"—January 31; six months.

Crofton William Moat, of Thistle Grove, Brompton, Esquire, for "*a new and improved method of applying steam-power to carriages on ordinary roads.*"—February 5; six months.

Wilkinson Steele and Patrick Sanderson Steele, Manufacturing Ironmongers, of George Street, Edinburgh, for "*improvements in kitchen ranges for culinary purposes and apparatus for raising the temperature of water for baths and other uses.*"—February 5; six months.

William Isaac Cookson, of Newcastle-upon-Tyne, Esquire, for "*certain improved processes or operations for obtaining copper and other metals from metallic ores.*"—February 5; six months.

Thomas Myerscough, of Little Bolton, and William Sykes, of Manchester, Machine Maker, for "*certain improvements in the construction of looms for weaving or producing a new or improved manufacture of fabrics, and also in the arrangement of machinery to produce other descriptions of woven goods or fabrics.*"—February 5; six months.

Samuel Carson, of Caroline Street, Coleshill, Eaton Square, Gentleman, for "*improvements in apparatus for withdrawing air or vapours.*"—February 5; six months.

Joseph Needham Tayler, of Plymouth, Captain in the Royal Navy, for "*improvements in steam-boats and vessels making applicable the power of the steam-engine to new and useful purposes of navigation.*"—February 8; six months.

John Wertheimer, of West Street, Finsbury Circus, Printer, for "*certain improvements in preserving animal and vegetable substances and liquids.*" Communicated by a foreigner residing abroad.—February 8; six months.

Robert Beart, of Godmanchester, Miller, for "*improvements in apparatus for filtering fluids.*"—February 8; six months.

Amand Deplangue, of Lisle, in the Kingdom of France, but now residing in Leicester Square, Gentleman, for "*improvements in looms for weaving.*" Communicated by a foreigner residing abroad.—February 8; six months.

Edmund Rudge, Jun., of Tewkesbury, Tanner, for "*a new method or methods of obtaining power for locomotive and other purposes, and of applying the same.*"—February 8; six months.

James Hancock, of Gloucester Place, Walworth, for "*a method of forming a fabric or fabrics applicable to various uses by combining caoutchouc, or certain compounds thereof, with wood, whalebone, or other fibrous materials, vegetable or animal, manufactured or prepared for that purpose, or with metallic substances manufactured or prepared.*"—February 8; six months.

George Eugene Magnus, of Manchester, Merchant, for "*certain improvements in manufacturing, polishing, and finishing slate, and in the application of the same to domestic and other useful purposes.*"—February 8; six months.

Robert Willis, of the University of Cambridge, Clerk, Tonksonian Professor, for "*improvements in apparatus for weighing.*"—February 8; six months.

David Napier, of York Road, Lambeth, Engineer, for "*improvements in the manufacture of projectiles.*"—February 12; six months.

Antoine Blanc, of Paris, Merchant, and Theophile Gervais Bazille, of Rouen, Merchant, now residing at Sablonieres Hotel, Leicester Square, for "*certain improvements in the manufacturing or producing soda, and other articles obtained by or from the decomposition of common salt or chloride of sodium.*"—February 12; six months.

Thomas Robinson Williams, of Cheapside, Gentleman, for "*certain improvements in the manufacture of woollen and other fabric or fabrics of which wool or fur form a principal component part, and in the machinery employed for effecting that object.*"—February 14; six months.

Joseph Clarke, of Boston, Printer, for "*improvements in piano-fortes.*"—February 14; six months.

Gerard Ralston, of Tokenhouse Yard, Merchant, for "*improvements in rolling puddle balls or other masses of iron.*" Communicated by a foreigner residing abroad.—February 22; six months.

Richard Cuerton, Jun., of Percy Street, Middlesex, Brass Founder, for "*improvements in the manufacture of cornices, mouldings, and window sashes.*" Communicated by a foreigner residing abroad.—February 22; six months.

Thomas Kerr, of Forecrofts Dunse, in the county of Berwick, Esquire, for "*a new and improved mortar or cement for building, also for mouldings, castings, statuary, tiles, pottery, imitation of soft and hard rocks, and other useful purposes, and which mortar or cement is applicable as a manure for promoting vegetation and destroying noxious insects.*"—February 22; six months.

William Cook, of King Street, Regent Street, Coach Maker, for "*improvements in carriages.*"—February 22; six months.

John Hanson, of Huddersfield, Engineer, for "*certain improvements in meters for measuring volumes of gas, water, and other fluids when passed through them, and in the construction of cocks or valves applicable to such purposes.*"—February 22; six months.

William Winsor, of Rathbone Place, Middlesex, Artists' Colourman, for "*a certain method or certain methods of preserving and using colours.*"—February 22; six months.

Job Cutler, of Lady Poole Lane, Sparkbrook, Birmingham, Gentleman, and Thomas Gregory Hancock, of Highgate, in the same Borough, Mechanist, for "*an improved method of cutting corks and constructing the necks of bottles.*"—February 22; six months.

William Brindley, of Northwood Street, Birmingham, for "*improvements in apparatus employed in pressing cotton, wool, and goods of various descriptions.*"—February 25; six months.

Thomas Huckvale, of Over Norton, Oxford, Farmer, for "*improvements in ploughs.*"—February 25; six months.

Thomas Farmer, of Gunnersbury House, near Acton, Middlesex, Esquire, for "*improvements in treating pyrites to obtain sulphur, sulphurous acid and other products.*"—February 25; six months.

John Wilson, of Liverpool, Lecturer on Chemistry, for "*an improvement or improvements in the process or processes of manufacturing the carbonate of soda.*"—February 25; six months.

Richard Kingdon, of Gothic House, Stockwell, Surrey, Surgeon, for "*certain improvements in apparatus for the support of the human body, and the correction of curvatures and other distortions of the spine of the human body.*"—February 25; six months.

Thomas Milner, of Liverpool, Safety Box Manufacturer, for "*certain improvements in boxes, safes, or other depositories for the protection of papers or other materials from fire.*"—February 26; six months.

William Morrett Williams, of Bedford Place, Commercial Road, Middlesex, late of the Royal Military College, and Professor of Mathematics, for "*an improved lock and key.*"—February 27; six months.

TO CORRESPONDENTS.

In our last Number we inserted a drawing and description of the Traversing Screw Jack, but we omitted to state that it formed part of Mr. Curtis's *patent inventions.*

We shall be happy to receive from Mr. *Armstrong, our valuable contributor, the proffered illustrations alluded to at the conclusion of his communication in the present month's Journal.*

Mr. Thorold's new frame for Steam Engine, we were compelled to postpone, together with several other communications for want of space, we will endeavour to meet the wishes of our numerous contributors next month.

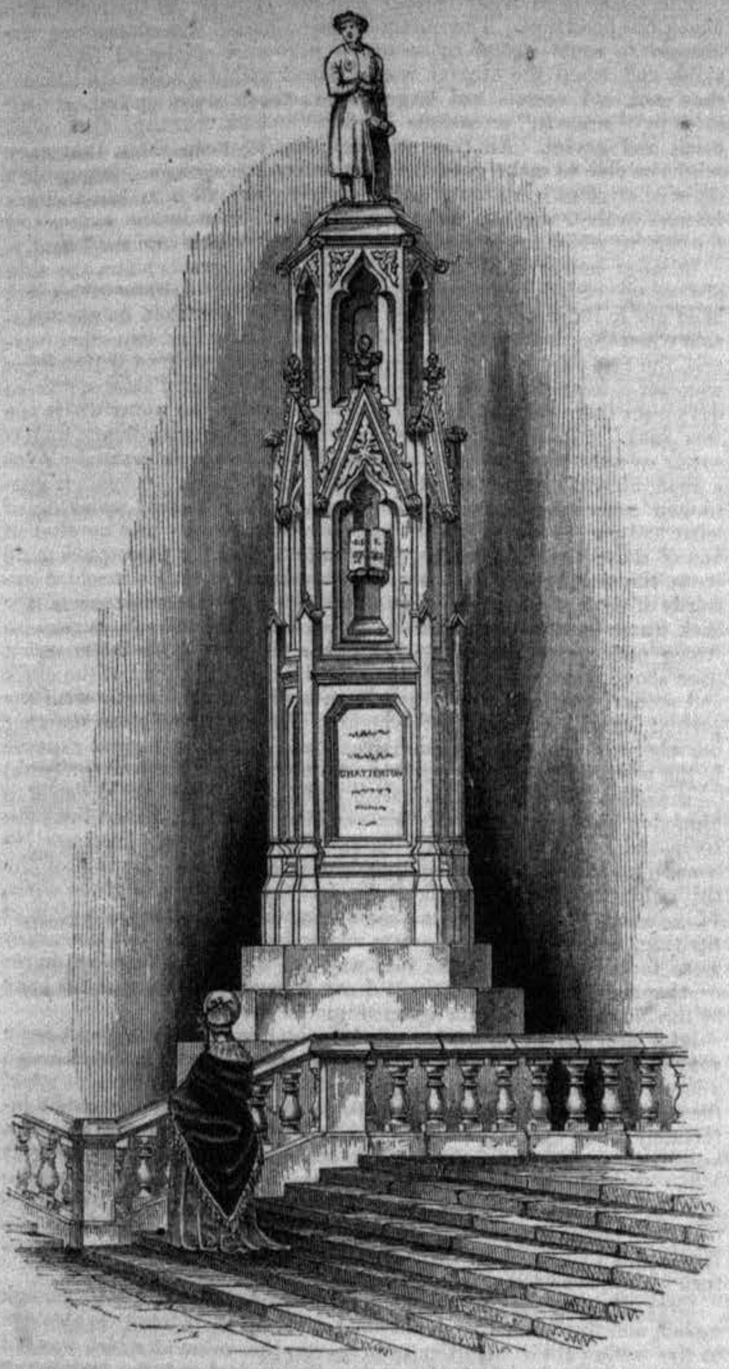
Communications are requested to be addressed to "The Editor of the Civil Engineer and Architect's Journal," *No.* 11, *Parliament Street, Westminster, or to Mr. Groombridge, Panyer Alley, Paternoster Row; if by post, to be directed to the former place; if by parcel, to be directed to the nearest of the two places where the coach arrives at in London, as we are frequently put to the expence of one or two shillings for the* porterage only, *of a very small parcel.*

Books for review must be sent early in the month, communications on or before the 20th (if with wood-cuts, earlier), and advertisements on or before the 25th instant.

The First Volume may be had, bound in cloth and lettered in gold, Price 17*s*.

*** The Second Volume may also be had, Price 20*s*.

MONUMENT TO CHATTERTON.

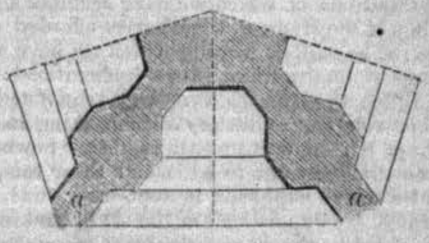


Admiration of Chatterton, and compassion for his untimely fate have too often evaporated in mere declamation, and it wanted the spirit of a few individuals, and the talent of a disinterested artist to give the poet that tribute, to which every one acknowledged his title "The wonderful boy who died in his pride," the bard who gave Bristol that title in the literary world, which has since been maintained by Southey, had a right to expect from his fellow citizens a memorial which they had money to pay for and native talent to execute—The Bristolians have shown good feeling in preserving in the museum of the Institute the Eve at the Fountain, and they would have shown still more, had they employed the pencil of Lawrence or the chisel of Baily upon a subject so worthy of their talents, as the commemoration of a fellow townsman.

To enter into a biography of Chatterton would be misplaced here, while the leading incidents need but to be alluded to to recall the remembrance of his life, his childhood,* his relationship to Redcliffe his education in the neighbouring charity school, and his years of fretful toil as an attorney's clerk, are circumstances of local interest connected with the present monument No site could be better chosen than one near the place of his birth and of his literary education, no garb could be more dignified than that which recalled the difficult position from which he had to emerge to distinction. It was within the walls of St. Mary's that he breathed the inspiration of his song it was there that he planned the tale of fiction which struck the literary world with wonder, it was there that he placed the stage on which the imaginary Rowley was to herald the fame of Chatterton. The discovery of the fiction is not to be regretted, it is only painful as it led to the self destruction of one so promising and so talented, and the loss of a life which beamed with hope of better works. His fellow citizens have been loud in sounding his fame, but half their duty was undone while they left the tenant of the workhouse ground in Shoe Lane, without a stone to tell his name.

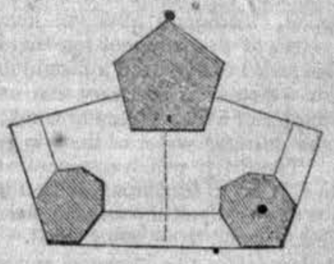
The people of Bristol have at last been alive to the claims upon them, but it is owing neither to their public spirit nor their generosity that the memorial is worthy of its subject. The paltry sum of one hundred pounds is what this rich city awards to commemorate its own glory, and that of its favorite son, and it is fortunate that the performance was not as mean as its reward. The monument, of Bath stone, is a Gothic cross, 31 feet high, bearing the statue of Chatterton, attired in the garb of the charity school in which he was brought up. The plan is pentagonal throughout, and harmonises with the rich architecture of the majestic church. The niches and tablet recesses are formed by alternate parallel surfaces with the face and side of the buttresses, as under:—

Plan of compartment in the middle stage of the Monument.
Scale ½ an inch to a foot.



The upper stage which is not shown minutely in our engraving is composed of five angular shafts detached from the central pier whic supports the statue; the light and shade are therefore much more varied.

Plan of compartment in the upper stage of the Monument.
Scale ½ an inch to a foot.



There are five inscriptions on the tablets in the lower stages, and the open book and the scroll in the hands of the statue are also inscribed, the two latter in Old English character. The work is well executed, the carvings in particular, which are designed after some of the fine models in Bristol Cathedral.

The monument was sure to excite interest from its locality, and this interest has been maintained by the skill with which the work is made to harmonize with the noble back-ground formed by the North Porch of the church, rich in all the luxuriant ornament of the fourteenth century. It is to Mr. S. C. Fripp, jun. an Architect of Bristol, that the public are indebted for this admirable work, and he has shown both judgment and true genius in preserving that harmony of tone, which was ditcated by a due regard to the proper treatment of the subject. Had Mr. Fripp done otherwise he would have stepped beyond his proper sphere, and failed in producing a work which does him so much honor. He has by this monument added fresh interest to a time honored site, given his native city a new ornament, and a noble bard his long neglected tribute.

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* Thomas Chatterton born 1758, died 1770.

ON DAGENHAM BREACH.

A brief account of the stopping of Dagenham Breach on the Thames digested from Captain Perry's *Narrative, published at London in* 1721.

Engineering has only within the last fifty or sixty years been considered a liberal profession in Great Britain. Formerly from its limited extent, and the want of education and science on the part of its professors, it was looked upon as a subordinate although an useful occupation. Although the profession has so greatly extended itself within that limited period as now to be recognized as a scientific avocation, we must not on that account suppose, that formerly there were not men engaged in its arduous works, who by their originality and boldness may be considered as worthy of memory. The work of which we are to subjoin a brief account was (like some others at the same period) conducted by a man of real genius and industry—one who although obliged by the slight encouragement given to his profession, to execute by personal *contract* the works which he designed, yet cannot be regarded as a mere pecuniary adventurer. Of his history all the information I have been able to gain has been gleaned from his writings, from which it would seem, and it is worthy of remark that his own country afforded such small scope for his genius, that he was obliged at one time to seek a livelihood under the Czar of Muscovy.

With regard to the work by which he so much distinguished himself, it was one of those unpretending yet costly works, the call for which, had it not been irresistible would have probably been disregarded, but it was a work that could admit of no delay, as every lost opportunity added to the difficulty of its completion. And it is to this cause we must attribute the laying out of such a large sum of public money in times so deficient of the spirit of enterprise.

Breaches in the Thames seem to have been of frequent occurrence in the earliest periods of which we have accurate accounts. So far back as the time of the Romans, the Thames afforded employment for the ingenious. The earliest work of which we have any information, was the drainage of Southwark and its neighbourhood; this was a sort of work with which the Romans were well acquainted. Sir William Dugdale in his voluminous history of Embanking and Draining (fol., London 1772, p. 81, 2d edit.) mentions that "howbeit these banks being not made strong enough to withstand those tempestuous storms and violent tides which happened in September 1621, Cornelius Vermuden, gentleman, (an expert man in the art of banking and draining) being treated withal by the commissioners of sewers appointed for the view and repair of the breaches then made, undertook the work and perfected it; but such being the perverseness of those *as* were owners of the lands assessed by the commissioners to pay their proportions thereof—upon complaint therefore made to the said commissioners, he the said Cornelius in recompence of his charges had parcel of the said lands assigned unto him, which assignation was by the king's letters patent confirmed to him the said Cornelius and his heirs."

I can find no account of the extent of this breach or the manner in which it was stopped. Although from the handsome remuneration with which the services of this eminent fen engineer were rewarded, we must suppose his task to have been a formidable one.

The breach with which Captain Perry was connected, was occasioned by the blowing up of a small sluice or trunk, that had been made for carrying away the drainage water of the low grounds adjoining the banks of the river. The ditch which communicated with this sluice was at first not above 14 or 16 feet broad, so that had the accident met with the attention it deserved, all the trouble and expence consequent on stopping the breach would have been saved. Instead however of prompt measures being taken, the damaged sluice was in the first instance neglected, and it was not until the tidal water had greatly enlarged the gap that attempts were made to stop the breach; but by this time the water had scoured away the clay bottom, and began to act upon what our author calls "Moorlogg," and the gravel and sand beds which lie out a little way below the surface of the ground. Moorlogg is described as a vein of matted brushwood, with nuts and pieces of rotten wood interspersed. In these soft strata the scour proceeded with great rapidity, and baffled all attempts which were made to check its progress during a period of no less than 14 years. In that time the tiny ditch had ramified above a mile and a half into the land, and its main branch had attained a breadth of about 400 or 500 feet, and a depth of from 20 to 30 or 40 feet. By a computation made at the time, no less than about 120 acres of marsh land had been carried into the Thames by this tidal river. The ground thus excavated and carried into the river was composed of clayey ground moorlogg, about a foot or 16 inches of blue clay, and at the bottom gravel and sand.

Nor was the loss of sand by any means the most serious consequence connected with this inroad of the tide; a more important although perhaps less apparent evil was the injurious effects produced by so large a quantity of matter lodging both in the higher and lower reaches of the Thames.

The landowners were neither idle nor illiberal in their efforts to check the incursion. The method they adopted was contracting the channel to some extent by means of pile-work advanced from both sides, and when the stream was confined within a moderate channel they sunk old vessels and large boxes; these were backed on both sides by "*maands*," or baskets filled with chalk, and bags filled with earth and gravel. All this was done during neap tides, that they might be able to make good the dam before the springs. Engaged in these operations were those in the vicinity, and all who had a direct interest in their success, and many lost their lives by the violence of the current which swept them away, and carried them into the Thames.

In spite however of all their activity and perseverance, the tide always succeeded in boring through below the obstructions which had been put in its way. With such violence did it act that on one occasion when they had sunk the "Linn" man-of-war and two other vessels, the first ebb of the tide swept them so completely away that there was not a fragment to be seen, and as Captain Perry asserts, "three days after there was upwards of 50 foot depth at *low* water where she was sunk." This depth, however, seems very extraordinary, and is surely overstated. He mentions another case which certainly gives a good idea of the force of the current (pp. 17, 18). "Another gentleman concerned (since my late stopping the breach) speaking of what had passed with them in their attempts, merrily told me that at one of those times when they had made a shut (or attempted to do it) by the sinking among other things, a large chest or machine upwards of 80 feet long, the next day afterwards the violence of the back water setting out of the levels upon the tide of ebb, worked so strong underneath the bottom of this machine that she bolted up at once above water, and discharging as she rose most part of the chalk and stones with which she had been sunk, drove directly with the current out of the mouth of the breach, whereat a gentleman standing by, who was a considerable landowner, and had been at great expense in the work, being much surprised, ran along upon the wall (or bank) on the side of the breach, and with great earnestness called out, stop him, stop him, oh stop him! this machine driving directly down the river, and sometimes sticking against the bottom and sometimes rebounding above the water again, when it came down in view of the ships at Gravesend, they were alarmed at the unusualness of the sight, as it emerged out of the water sometimes with and sometimes athwart the tide, and as they ride pretty numerous there at that time, they were forced to sheer, some one way and some another to avoid receiving any mischief from it It drove from thence as far as the buoy off the Nore, and there run aground upon a shoal."

At a later period they succeeded in keeping in their places some vessels which had been sunk by driving piles on each side, but although a large quantity of chalk in bags and baskets had been sunk all round them, the tide still rose and fell within. So much were the public interested in the operations that a power was given to impress all chalk vessels that passed on the river, so that sometimes 10 or 15 freights a-day were delivered at the breach, which was actually reported to have in some measure retarded the London buildings. An extraordinary tide happening soon after, put a stop at once to the embargo on chalk, and to the works at Dagenham, by removing the whole structure which had been erected at such cost and labour.

Here all exertions on the part of the landowners naturally enough ended, and they would no doubt have made up their minds to abandon to the waters their unfortunate property, the value of which was not adequate to warrant a farther expenditure, had not the destructive effects of the silt lodging in the Thames arrested the attention of the House of Commons, which passed a bill in April 1714, for effectually stopping the breach at public expense, and this they farther extended to removing the silt which had been deposited in the river, and making good the adjoining banks. Captain Perry offered to execute the works for £24,000, and a Mr. Boswell for £16,500, which being the lowest offer was accepted.

Mr. Boswell was first to make piers and then sink 6 ponts or chests 60 feet in length, 30 feet broad, and made salient at each end like the starlings of a bridge. These were to be placed in the bottom 12 feet apart, and the spaces were to be made up with piles and other timber work.

In the chests were to be sluices which when shut down were wholly to exclude the water. But the gap was no sooner contracted by the piers than the current scooped out the soft bottom which was the cause of the miscarriage of all the former plans. Thus was Mr. Boswell's first plan completely set aside. He had then recourse to one enormous box, but whenever he attempted to contract the water-way, as certainly did the bottom wear and assume an irregular deep rutted surface, so that after all these schemes he was constrained to return to the old system of staunching the current by the sinking of ships, ponts, and bags of chalk. The only new feature which he introduced into the plan was the fixture of enormous hair bags filled with chalk (some of them 30 feet in length) to the vessels bottom, which bags it was expected would have adapted themselves to the form of the bottom, and thus preserved a closer connection than had been effected before. He accordingly carried out his scheme, having sunk two vessels and the large pontoon which he had previously made, and he also surrounded the whole fabric with enormous quantities of chalk. In addition to this he had placed in the banks a little below the breach, two sluices which were intended to have relieved the pressure, but which according to Captain Perry could not from their construction and level have been of any service. The very first tide after the vessels had been sunk, operated with such energy on the bottom, that the whole fabric was totally destroyed by the second day after. The vessels laden with chalk and rubbish were thrown up, and the enormous pontoon gave the finishing blow by starting up and tearing to pieces the pile work and planking.

Here ended Mr. Boswell's services, and the trustees appointed by the bill having nominated a committee, inspected the ground and drew up a report dated November 7, 1715. The following soundings taken by the committee and given in their report are as follows: "on the west side 20 feet below the works to the south, 40 feet deep. On the south side 20 feet from the stern of the Abindon (one of the ships sunk in the said breach, 30 feet. On the same side, 15 feet from the stern of the Recovery, (another ship) 18 feet. Ten feet south from the piles on the east side of the breach 18 feet. Between the ships and the piles on the west side 29 feet. Betwixt the works to the northward near the piles on east side 24 feet. At the end of piles on east side 19 feet. Fifty feet north from said piles 31 feet. Fifty feet farther north 50 feet. Twenty-five feet north of the piles on the west side 26 feet. Fifteen feet north from piles in west side 14 feet. Close to said piles on west side 20 feet. Coming about the piles to the southward we find these depths following, viz., 29, 24 and 18 feet."

What sort of settlement was made with Mr. Boswell does not appear from the narrative, but new offers were obtained. Captain Perry gave in an account of his scheme, which was this. To have a sluice made in the embankment with a trench connected with the backwaters. To drive a row of *dovetailed* piles across the gap, leaving their heads not more than 18 inches or 2 feet above low-water mark; so that in driving these piles little or no difficulty would be experienced from the current. Forty feet from the row of piles on either side a sort of low coffer-dam 18 or 20 feet broad, to be formed of piles and boarding, and to be filled with chalk to prevent the toe of the embankment from spreading. On the outside of these coffer-dams a wall of chalk to be made as a farther security. The dam itself to be composed entirely of earth, and in the course of the erection care to be taken always to shut the sluice when the backwater falls to the level of the top of the work. In this way there will at no time be a higher face for the water to flow over.

This was evidently a judiciously contrived scheme, and shows that the projector of it had a just conception of the nature of the difficulties he was to contend with, which were a soft, unstable bottom and a powerful current of water. He was well aware that a dam of the thickness he contemplated would easily sustain the *pressure* of backwater, although from its being composed of soft materials, he could not expect it to withstand the action of water rushing over it. Experience had proved that such materials as chalk could not from the large interstices necessarily existing between the pieces, form anything like a water-tight dam, and if they had, the softness of the bottom was enough to render such a plan impracticable. The first grand points were to secure the treacherous bottom, and make a heavy and water-tight dam. These difficulties were well provided for by the use of dove-tailed piles and a clayey soil. The second point was to prevent the ebb and flood tides from rushing over the top of the dam when it was in progress; this difficulty was removed by keeping the backwater constantly on a level with the top of the work.

After much communing and trouble on both sides, a contract was entered into with Captain Perry, who was to perform the works for £25,000, be being bound to advance £5000, and to expend that sum on the works, after which he was to be supplied by the trustees. If the work were unsuccessful, the £5000 was of course lost to Captain Perry, or, rather, to the friends who had advanced it. Should, on the other hand, the work be successful, but be rendered very costly from any unforeseen accident, he was to be recommended to the consideration of Parliament.

After all this had been settled, Captain P. seems to have been much annoyed by Mr. Boswell and a host of *mathematicians*, who declared his plan impracticable. He, however, came through their hands, according to his own account, *non sine gloria*, as well as through the ordeal of sundry examinations and meetings.

No time was lost in commencing the work; but the sluice, from the softness of the ground, was not carried to its contemplated depth, which incurred the necessity of another being made. From some cause or other matters seem to have been mismanaged, for it was not until the spring of 1717 that the second sluice was completed, and the breach was not stopped till June. For this tardiness he pleads several excuses, but he does not succeed in satisfying the reader as to his promptness. The time for completing the dam had now nearly approached, and his friends who had advanced the money, became impatient, and so importuned him to push on the work, that he allows he was persuaded to admit stuff of an inferior binding quality in the formation of the dam. A great deal of bad earth was also put in without his knowledge, when the men were working at night, and his assistants, five in number, seemed rather to conspire against him than to back him in any of his difficulties, so that what between grumbling friends, rebellious assistants, and an impatient public, he was constrained to collect together all the force he could muster in the neighbouring country, in spite of the high wages of 36s. per week. These labourers, assisted by men from the royal yards of Woolwich and Deptford, soon made a satisfactory difference in the appearance of the work, but a most unsatisfactory difference in its quality. Hitherto each tide's work had been made in offsets or scarcements, about 7 feet broad and 3 feet high, these supported by piles and planking on the side, and protected by reeds on the top, had been able to resist the action of the tide when it came in. One of the assistants, however, proposed during the neaps to set all hands to work and make a narrow wall of earth, unprotected by reeds or planking, and build it so rapidly as to get it above the level of the springs before they should come on, and thus at once to exclude the tide from the marsh. Captain Perry unfortunately gave in to this proposal, trusting to the tide's being of its ordinary height. There happened, however, an extraordinary tide, occasioned by a storm at N.W., which tide rose about 6 inches higher than the top of the little wall, and pouring over it, soon washed it down, and the water thus widening its inlet, rushed over in such volumes, that in the course of two hours the dovetailed piles were laid bare.

When Captain P. observed the tide rising with unprecedented rapidity (which it did), he heightened the little wall with piles and boarding set on edge on the top, but the water insinuating itself between the boards and the earth, led to the calamity we have mentioned, and which the Captain says was due merely to the fortuitous occurrence of an extraordinary tide. Men were employed in digging down the earth, and otherwise easing the passage of the water over the dam, as well at the first inbreak as at subsequent tides, by which means the violence of the current was speedily checked.

This accident, as might have been supposed, caused many reports about the general insufficiency of the work, and the erroneous principles on which it had been carried on. This did not, however, deter Captain P. from proceeding with the repair during the winter months, and in raising the dam this second time, he was a great deal more scrupulous about the quality of earth used in its formation, and in the end of June, 1718, "the tide was again turned out of the levels in the time of neap as before, only that the work, after the tides were turned, was now continued to be raised by set-offs with piles and boards, and well covered over at the top, so that though a thin body of water did several times pass over into the levels, it was easily let off by the sluices. The trustees now visited the work, and expressed themselves satisfied with the manner in which this part of the work had been accomplished. After their visit he dammed up the two canals communicating with the sluices, and any subsidence of the dam he at once made up with new stuff The work being now in an apparently safe condition, the Captain left for Dover, where he was to report on the Harbour, and on his return he was seized with ague, and when he was recovering, but was still confined, on the morning of the 30th of September, 1718, a message was sent to him conveying the mortifying intelligence that the tide had again demolished the work. In spite of his ague he at once visited the spot, and found the sluice dams standing and the sluices shut, and, in short, nothing done towards easing the passage of the waters. He immediately summoned as many hands to his assistance as the neighbouring country could, on such short notice, produce; but the water had made such havoc, that in six tides about a hundred feet of the dovetail piles, &c., were torn up and carried away, and in one place there was about 20 feet greater depth than there was before the work was begun.

How this accident occurred was for some time a mystery, but it subsequently came out that the watchman had, instead of attending at his post, been reviving his frozen carcase at a neighbouring beer shop.

By this time the Captain's funds had been greatly reduced, and he applied to the trustees for a remittance, which they, however refused and he was reduced to the necessity of canvassing his friends for further sums which was after some difficulty supplied. This was in February, and it was not till the winter had expired that the gap was squared and filled up and the tides were expelled for the third time on the 18th of June. He continued also to increase the height of the dam till it was two feet above the level of a high tide that occurred in November, occasioned by the conjoined effects of a great storm and the moon's being in perigee.

It appears from his statements that the works had left him in a sadly crippled state as far as regarded his purse, and he concludes by urging the trustees at least to make up his deficiency that he might be enabled to steer clear of his creditors. He says "If I may—now the work is completed and so many years (5) spent therein, be but freed from the debts and engagements into which it has plunged me, and set at liberty to offer myself upon some other work, whereby I may be of use to my country and have an opportunity of getting my bread; I shall cheerfully submit to whatsoever shall be thought fit as to any consideration or reward to myself." He further volunteers his services for the improvement of the ports of Dublin and Dover, reports on both of which he subjoins to his narrative. I cannot, from the want of access to proper data (occasioned by a casual visit to the country), take any step towards ascertaining in what way the petition of our author was received by the Trustees and the house of parliament, as such information is not contained in his own narrative, that he was in some way freed from actual imprisonment and allowed to go at large in the practice of his profession, seems evident from the book which he subsequently published. In the Bibliotheca Britannica there is mentioned in the short catalogue of his labours as an author "Proposals for the draining the Fens in Lincolnshire. 1727 fol. His death is said in the same book to have taken place in 1733.

I shall now conclude by explaining my reasons for thus having brought a condensed view of this half forgotten work before the public through the medium of these widely circulated pages. Many who might have taken an interest in the work have no opportunity of reading Perry's own narrative from its unfrequent occurrence; and from the somewhat incoherent and cloudy stile in which it is written, the reader is frequently a little puzzled to know exactly what the author would be at. Even the description of his scheme (simple though it was) is not by most readers to be apprehended by a single perusal. These reasons and the wish to make the name of the successful projector of so formidable a work, better known to the profession must excuse me for occupying so much valuable room.

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STEAM VESSEL INQUIRY AND INQUISITION.

THE labours of the Commissioners have at last brought to light the promised Shiloh, in the shape of such a bill as was never before seen, and we sincerely hope will never be seen again. The abstract which we have perused is such as was to have been expected from its concoctors, and the sources from which they derived their ideas of legislation; the bill seems to be a cross breed between a French police ordonnance, and an excise or custom-house act of parliament. Such inspectors and such surveyors, and such modes of action, were never before contemplated in this country, at variance with the recognized laws of all sound economy, they are obviously at variance with the national character, and the interests of the empire. It is by unshackled industry and by that alone that this mighty empire has been created, and that it is to be maintained, and it is on the prosperity of steam navigation in particular that our strength depends, and the means of profiting by our resources. What therefore can exceed the insanity which proposes to place inventors and manufacturers under a yoke, which in every other country has fettered the progress of science, and retarded the advancement of the nation? What are we to expect when we see spies under the name of surveyors introduced not only into the workshops, but into the study, not to be contented by tampering with the machinery, but who must meddle with the very design itself. Men who are to constitute a new middle class between the manufacturer and the shipowner, who are to tell one what he is to make, and the other what he is to buy, who are to be censors of the noblest efforts of invention, and judges of last resort in cases where the most learned disagree. Do we believe that the plague introduced among marine engineers will fester among them alone without extending to every other class of engineers? We neither believe it, nor can others. It is what is done in France and what will be done here; the police will not stop till they regulate the working of the engine in the factory, as well as the progress of the steam boat on the water, and the locomotive on the rail. To denounce this to Englishmen is unnecessary, to name it is to point out its train of informers and penalties, and to insure its instant condemnation.

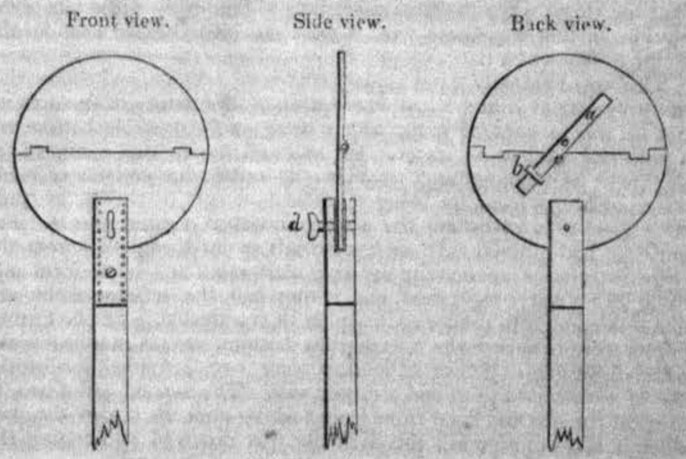
The motives which inspire this bill, can have no origin in common sense, they can proceed only from some hateful inspiration, and what that is it would be difficult to point out. The least excusable would be to enable a government, always in arrear of private enterprise, to pillage in other establishments for the maintenance of the new factory at Woolwich. We cannot believe that they would hesitate to do so, when they are regardless in every other point.

We felt it our duty to oppose this measure from its first suggestion, we have followed it with uncompromising hostility throughout its threatening progress, and we were not inclined to relax when we saw it assume a shape so formidable. Having issued a circular to the manufacturers, meetings have been held at which men, the first in talent, enterprise and wealth in the country have come forward to prove by their own conduct the justice of the course which we had pursued in their defence, and we trust that such an opposition is organized as will at least paralyze the operations of this obnoxious bill, if it do not destroy it in its birth.

We have on former occasions shown that the evidence on which the report was founded was most trumpery and insufficient, and we trust that our readers are convinced, that the only effective operation of the proposed measure would be to injure the best interests of the country. Commissioners of course are to be appointed, but where men competent for the duty are to be found, none but the concoctors of the bill can devine, for no practical man can. Qualified surveyors are still less to be expected, and raw theorists or ignorant empirics seem to be the classes from which these inquisitorial functionaries are to be supplied. To them are to be confided the most extraordinary powers, not only the mere privileges of meddling, but judicial authority over their victims. Even district surveyors are to have all the extra legal powers of a parliamentary committee, to call for papers and for documents, and to examine persons on oath, to prosecute for penalties, and to receive half those penalties for their own share. This is the plan to which all principles of justice, of truth, and of experience are to be sacrificed, and by which the talents and intellects of our ablest men are to be subjected, and manufacturers, some of whom have not less than a hundred thousand pounds invested in their business, are to be hampered and destroyed.

SURVEYING POLES.

SIR,—Allow me through the medium of your interesting Journal, to suggest to practical Surveyors a very useful, although seemingly trivial addition to the ordinary Surveying Poles, as a substitute for the piece of paper commonly used to render the pole distinguishable from a long distance when driving a line over land.


Front view. Side view. Back view.

It consists of a disc of tin about six inches in diameter, which for convenience in carrying may be joined across the middle as shown in the accompanying sketch; its open position being secured by a little bar A to be turned into the latch B. An iron ring or socket C is screwed on the top of the pole and receives the disc in a slit while the screw D secures it. It is almost needless to remark that the disc should be painted white on both sides.

Yours obediently,
G. P. DEMPSEY.

14, Craven-street, Charing Cross,
March 19, 1840.

OF THE OBLIQUE OR SKEWED ARCH.

WHILE the system of communication from one part of the country to another continued to be transmitted through the medium of turnpike roads alone, the instances were few and far between in which the erection of an *oblique or skewed arch* became necessary. Indeed, unless in very confined and precipitous situations, we do not recollect a single case, where a structure of this kind has been resorted to for the purpose of carrying a road over a river or streamlet; nor was it requisite that it should, for in laying down the original plan of a road, the surveyor would generally possess the power of directing it, so as to intersect a river at right angles to its banks, and thus the necessity of carrying a bridge obliquely across the stream would be altogether avoided.

On the introduction of canals however, the circumstances were very materially altered, for it seldom happened that the direction of a road already constructed, was permitted to be changed for the purpose of accommodating it to the line of a projected canal, so as to traverse it perpendicularly; and in many cases it would be found inconvenient if not totally impracticable, to guide the canal across a road at right angles to its direction; hence the necessity of having recourse to the *skewed arch*, and accordingly, on the various canals that intersect the country, erections of this sort are very numerous, and the methods by which some of them have been constructed are exceedingly ingenious.

But it is in the construction of railroads that the *skewed arch* meets with its most important application, for in almost every instance where one line is intersected by another, the intersection takes place with a lesser or greater degree of obliquity, and several viaducts of considerable length are wholly supported by a connected range of oblique arcuation. This being the case, it is an object of the greatest importance that the correct principles of construction should be rightly understood, and it is for the purpose of establishing those principles and rendering their application easy, that the present investigation has been instituted.

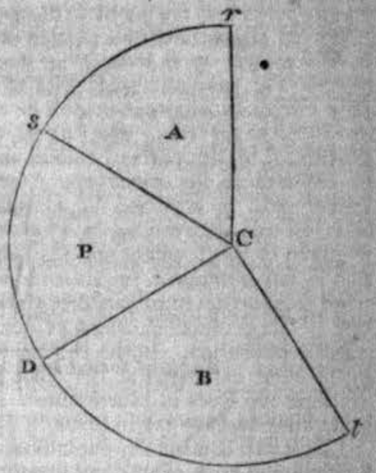
There are few architectural subjects that have excited a higher degree of interest than the present, and there is none that has given rise to a greater number of curious, abstruse and elegant theories, or been the cause of more violent and protracted controversies. One party contending that the just principle of construction, is to place the several courses of which the arch is composed in a direction parallel to the abutments, the direction of the coursing joints being regulated by the nature of the curve on which the arch is built. A second party maintains, that the several courses should be placed perpendicular to the face of the arch as far as the obliquity on both sides of it, and that the middle portion which stands upon the square, should have the courses laid parallel to the imposts of abutments. A third class of disputants insists upon laying the several courses perpendicular to the face of the arch throughout its whole extent, and trending them to the abutments in an angle dependent on the given obliquity; while a fourth class proposes to direct the courses in such a manner as to traverse the arch spirally like the threads of screw.

The subject itself is worthy of a mechanical investigation, and since we have been induced to direct our attention to it, we shall endeavour to the utmost of our power to set the question at rest, and point out the true principles of construction upon which depends the maximum of stability and strength.

In taking a minute and comprehensive view of the subject to which our present enquirles are directed, it will be proper for the sake of system, to consider the various theories above specified in the same order as we have described them. This in the first place will lead us to the contemplation of that variety where the courses are laid in a direction parallel to the imposts, and in which, (supposing the arch to be a semicircle,) the planes of the coursing joints on being produced to intersect the plan or base of the arch, are everywhere constrained to terminate in the axis or straight line, which passing through the centre of the semicircle divides the plan into two equal and similar portions.

The principle upon which the mechanical delineation of this particular form is founded, is exceedingly curious and interesting, referring as it does to the developement of the several parts of a right angled triangular pyramid upon a plane surface. This circumstance introduces a species of calculation that is not generally understood by practical architects, since it claims as its basis the doctrine of Spherical Trigonometry, a subject to which the attention of practical men is very seldom directed, although its applications are both numerous and important, and its principles remarkable for their elegance and simplicity. The objects of calculation are, the angles at the vertex of the pyramid comprehended between its edges, and the angles which measure the mutual inclinations of its bounding planes. Now, in order to assimilate the necessary operations to the determination of the levels or moulds by which the several voussoirs or arch stones are framed, we have only to consider the nature of the figure arising from the mutual intersections of the planes to which the moulds are severally applied.

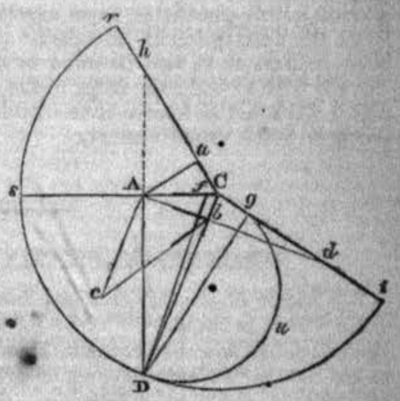
If the face or elevation of the arch, and the planes of the coursing joints or beds of the several voussoirs, be produced to intersect each other in the plan or base on which the arch is raised, they will, in connexion with the said plan, manifestly constitute a series of triangular pyramids having their vertices in the centre of the semicircle, and if the face of the arch be perpendicular to the plan, the pyramids will be all right angled; that is, two of the bounding planes in each, namely, the face and plan of the arch will intersect one another in an angle of ninety degrees.



Let the planes of the beds or coursing joints be produced externally, and conceive a circular arc to be described in each of the bounding planes, and having the vertex of the pyramid as a centre; then, the figures thus constituted will respectively resemble that which is exhibited in the margin, and upon the developement of which the construction of the arch depends.

A, part of the arch. P, part of the plan. B, part of bed prolonged.

If the middle plane or plan *s* C D be supposed to be fixed, while the extreme planes *r* C *s* and D C *t* are elevated about the lines C *s*, C D, till the points *r* and *t*, as also the radii C *r* and C *t* coincide, the nature of the figure thus formed will become manifest, and the expansions of its several parts upon a plane surface, may be effected in the following manner.



With the chord of 60 degrees taken from a scale of any convenient magnitude at pleasure, and about C as a centre, describe the circular arc *r s* D *t*, upon which and from the same scale of chords, set off *r s* and *s* D, respectively equal to the measures of the angles at the vertices of the perpendicular planes *r* C *s* and *s* C D.

Draw the radii C *r*, C *s* and C D, and in the radius C *r* take any point *a* at pleasure, and erect the perpendicular *a* A meeting the radius C *s* in the point A. At the point A determined in this manner, erect the perpendicular A D meeting the radius C D in the point D. From A, and on the radius C *s* set off A *f* equal to A *a* and draw D *f*. Upon C D as a diameter, describe the semicircular C *u* D, in which lay off the chord C *g* equal to C *a*, and D *g* equal to D *f* and draw the radius C *t*.

The above operation developes the triangular pyramid as far as it relates to the construction of the arch in question; D C *t* being the bevel of the bed or coursing joint, and A *f* D the bevel between the coursing joint and face of the arch. But in order to exhibit the complete developement of the figure, it is necessary to determine the angle which measures the inclination of the planes *s* C D and D C *t*; that is, the angle contained between the plan of the arch and the bed of the voussoirs for any particular course. From A or any other point whatever in the radius C *s*, let fall the perpendicular A *b*, carrying it forward to meet C *t* in *d*; then is A *b* the base, and *b d* the hypothenuse of a right angled plane triangle, between which the required angle lies. At the point A in the straight line *d* A, erect the perpendicular A *c*, and make *b c* equal to *b d*; then is A *b c* the angle sought, which having been found, the developement of the pyramid is complete.

The nature and principles of the above construction will be readily perceived by reversing the process; that is, by recomposing the figure from its constituent planes and the angles which measure their inclinations: and for this purpose, let the two extreme planes *r* C *s* and D C *t* be turned about the radii C *s* and C D, while the middle plane *s* C D remains fixed; and at the same, let the triangular planes A *f* D and $A b c$ be respectively turned about the lines $A D$ and $A b$. Then it is manifest, that when the points r and t are made to coincide, the radii $C r$ and $C t$ coincide also, and form one of the edges of the triangular pyramid, as may be seen by elevating the corresponding planes in the preceding diagram; and by this means the figure is recomposed in so far as respects its constituent planes. Another step of the composition is effected by bringing into coincidence the straight lines $A a$, $A f$, and $D f$, $D g$; and when $b c$ falls upon $b d$ the structure is complete, both as respects the bounding planes and the angles which measure their inclinations.

It now remains to calculate the several parts of the pyramid, on the supposition that the angles at the vertices of the planes $r C s$ and $s C D$ are given; and in order to this,

Let $c = r C s$, the angle at the vertex of the plane $r C s$, which corresponds with a portion of the face of the arch,
$b = s C D$, the angle at the vertex of the plane $s C D$, which corresponds with a portion of the plan or base, and is perpendicular to $r C s$,
$a = D C t$, the angle at the vertex of the plane $D C t$, which is a portion of the bed or coursing joint, and subtends the inclination of the planes $r C s$ and $s C D$,
$B = A f D$, the angle that measures the inclination of the planes $r C s$ and $D C t$,
and $C = A b c$, the angle that measures the inclination of the planes $D C t$ and $s C D$.

This notation being agreed on, let $C A$ be made the radius; then by the definitions of trigonometry, $A a$ and $C a$ are respectively the sine and cosine of the angle $A C a$, while $A D$ is the tangent of the angle $A C D$. But by the construction, $A f$ is equal to $A a$, and consequently $A f$ is equal to the sine of the angle $r C s$; therefore, by the principles of plane trigonometry, we have

$A f : A D :: \text{rad.} : \tan. A f D$; that is, $\sin. c : \tan. b :: \text{rad.} : \tan. B = \tan b, \operatorname{cosec} c$.

Here we have determined the angle of inclination between the planes $r C s$ and $D C t$, and a similar process will discover the angle $A b c$, or the inclination between the planes $s C D$ and $D C t$. Thus, since $C A$ is radius, $A b$ is the sine of the angle $s C D$ to that radius, and by construction, $A c$ is equal to the tangent of the angle $A C a$, for $A c$ is equal to $A h$, and $A h$ is evidently the tangent of the angle $A C a$ to radius $C A$; therefore, by plane trigonometry, we get

$A b : A c :: \text{rad.} : \tan. A b c$; that is, $\sin. b : \tan. c :: \text{rad.} : \tan. C = \tan. c, \operatorname{cosec}. b$.

We have next to determine the angle $b C d$ in the plane $D C t$, and for this purpose it is only necessary to recollect, that $C g$ is equal to the cosine of $A C a$, and $C D$ equal to the secant of $A C D$; hence we have

$C D : C g :: \text{rad.} : \cos. D C g$; that is, $\sec. b : \cos. c :: \text{rad.} : \cos. a = \cos. b, \cos. c$.

And exactly in the same manner, if any other two of the parts be given the rest may be found, and the several results when calculated and reduced to their simplest form, are respectively as exhibited in the following table:

Table of formulæ for calculating the several parts of a right angled triangular pyramid standing on a spherical base.

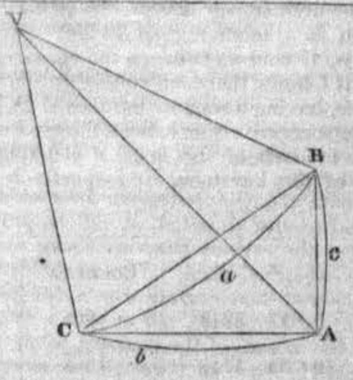
	Values of the angle B, subtended by the base or plane A V C.
1	$\sin. B = \sin. b \operatorname{cosec}. a.$
2	$\sin. B = \sec. c \cos. C.$
3	$\tan. B = \sec. a \cot. C.$
4	$\tan. B = \tan. b \operatorname{cosec}. c.$
5	$\cos. B = \cot. a \tan. c.$
6	$\cos. B = \cos. b \sin. C.$

	Values of the angle a, at the vertex of the hypothenusal plane B V C.
1	$\sin. a = \sin. b \operatorname{cosec}. B.$
2	$\sin. a = \sin. c \operatorname{cosec}. C.$
3	$\tan. a = \tan. b \sec. C.$
4	$\tan. a = \tan. c \sec. B.$
5	$\cos. a = \cos. b \cos. c.$
6	$\cos. a = \cot. B \cot. C.$

	Values of the angle c, at the vertex of the perpendicular plane A V B.
1	$\sin. c = \sin. a \sin. C.$
2	$\sin. c = \tan. b \cot. B.$
3	$\tan. c = \tan. a \cos. B.$
4	$\tan. c = \sin. b \tan. C.$
5	$\cos. c = \cos. a \sec. b.$
6	$\cos. c = \cos. C \operatorname{cosec}. B.$

	Values of the angle C, *subtended by the perpendicular plane* A V B.
1	$\sin. C = \sin. c \operatorname{cosec}. a.$
2	$\sin. C = \sec. b \cos. B.$
3	$\tan. C = \sec. a \cot. B.$
4	$\tan. C = \tan. c \operatorname{cosec}. b.$
5	$\cos. C = \cot. a \tan. b.$
6	$\cos. C = \cos. c \sin. B.$

	Values of the angle b, at the vertex of the plane or base A V C.
1	$\sin. b = \sin. a \sin. B.$
2	$\sin. b = \tan. c \cot. C.$
3	$\tan. b = \tan. a \cos. C.$
4	$\tan. b = \sin. c \tan. B.$
5	$\cos. b = \cos. a \sec. c.$
6	$\cos. b = \cos. B \operatorname{cosec}. C.$



The above table contains the simplest forms of the equations necessary for resolving the different cases and varieties of right angled spherical triangles, as they depend upon the triangular pyramid V B A C. It is designed to preclude the necessity of either learning by rote or investigating the various rules and proportions connected with this branch of the subject; for by simply referring to that compartment of the table which contains the values of the quantity sought, an expression will be found denoting the precise operation to be performed for the value of the required term. Thus for example. Suppose that in the right angled spherical triangle $B A C$, the base $A C = b$, and the perpendicular $B A = c$ are given, and it is required to find;

1. The hypothenuse $B C = a$.
2. The angle $A B C = B$ contained between the hypothenuse $B C$ and perpendicular $B A$, or that which is subtended by the base $A C$.

To find the hypothenuse $B C = a$, refer to that compartment of the table that contains the values of the hypothenuse, and select that expression which exhibits a combination of the given quantities b and c This is readily perceived to be No. 5, the only case in which the two given terms form an equation with the one required; hence we get

$$\cos. a = \cos. b \cos. c.$$

And the numerical operation denoted by this expression, may, when converted into words, be read in the following manner:—

Multiply the natural cosine of the given base, by the natural cosine of the given perpendicular, and the product will give the natural cosine of the hypothenuse.

The multiplication of trigonometrical quantities is however a very laborious process, unless the contracted method of decimal multiplication is resorted to; and since very few of our practical mechanics have taken the trouble to familiarize themselves with the application of that method, the necessity of employing it may be entirely superseded by the use of logarithms. The rule will then be as follows:—

Add together the logarithmic cosines of the given parts, and the sum will be the logarithmic cosine of the part required.

NOTE.—The reader is supposed to have a previous knowledge of the trigonometrical definitions, logarithmic tables, and algebraic notation.

The general application of the table may be described in words at length in the following manner:—

Add together the logarithms of the two given quantities according to their names in the equation, and the sum will give the logarithm of the required quantity according to its name in the particular combination employed, observing always to abate 10 in the index of the resulting logarithm.

Again, to find the angle A B C = B, contained between the hypothenuse and perpendicular, we have only to refer to that compartment of the table containing the values of B, and to select the combination which involves the given quantities; in this case it is No. 4, from which we have

$$\tan. B = \tan. b \operatorname{cosec} c;$$

an equation which is readily reduced by the general rule given above.

In reference to the arrangement of the table, it may be remarked that it forms a right angled triangle, the same as the figure under consideration, and the squares or compartments containing the values of the several parts, are placed in the same positions with respect to each other as the parts are whose values they contain. Thus, in the figure B A C, the hypothenuse a occurs between the angles B and C; so in the table, the square containing the values of the hypothenuse, is placed in a diagonal direction between the squares containing the values of the angles B and C.

In the figure the perpendicular c occurs between the angle B and the right angle at A; so in the table, the square containing the values of the perpendicular, occurs between the square containing the values of B, and the blank square for the right angle where no value enters.

Finally, in the figure, the base b falls between the angle C and the right angle at A: so in the table, the square containing the values of the base, is placed between the blank square for the right angle and the square containing the values of the angle C; an arrangement which is beautifully adapted for the purpose of a speedy reference.

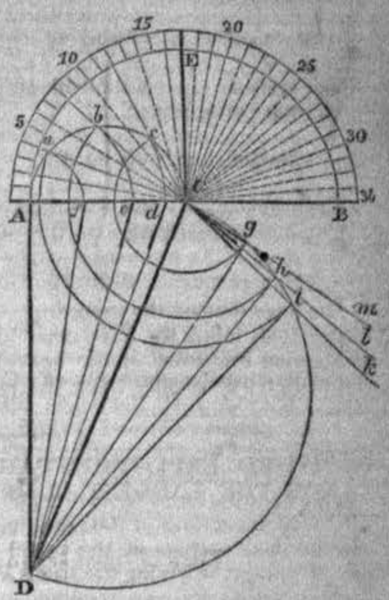
The two equations that we have selected from the table, are those which apply to the determination of the bevels for the several voussoirs throughout the whole extent of the arch. The first determines the form of the beds, or the angle contained between the joints in the face of the arch, and the corresponding joints along the soffit; and the second determines the angles contained between the face of the arch and the beds of the several courses. The application of which we now proceed to illustrate by means of an example.

Suppose a semicircular arch of 30 feet span, and consisting of 34 courses from impost to impost, to be built upon an obliquity of 68 degrees with the abutments, what are the several bevels required for the construction of the arch stones or voussoirs in each of the courses?

Since the arch is a semicircle of 30 feet span and consisting of 34 courses, that is, 17 courses between the crown of the arch and each of the imposts; it follows, that each voussoir occupies 5° 17′ 38″ $\frac{14}{17}$ of the circumference, having a soffit or intrados of 2·795 feet very nearly; consequently, the successive portions of the circumference, estimated from the impost to each of the beds or coursing joints as far as the crown or middle of the keystone, are respectively as in the following tablet.

COURSES.	°	′	″	COURSES.	°	′	″
1st	5	17	38$\frac{14}{17}$	9th	47	38	49$\frac{7}{17}$
2nd	10	35	17$\frac{11}{17}$	10th	52	56	28$\frac{4}{17}$
3rd	15	52	51$\frac{6}{17}$	11th	58	14	7$\frac{1}{17}$
4th	21	10	35$\frac{5}{17}$	12th	63	31	45$\frac{14}{17}$
5th	26	28	14$\frac{2}{17}$	13th	68	49	24$\frac{12}{17}$
6th	31	45	52$\frac{16}{17}$	14th	74	7	3$\frac{9}{17}$
7th	37	3	31$\frac{13}{17}$	15th	79	24	42$\frac{6}{17}$
8th	42	21	10$\frac{10}{17}$	16th	84	42	21$\frac{3}{17}$

The 17th course, or course at the crown of the arch, corresponding an angle of 90 degrees as it ought to do, when the keystone is in two parts, as we have assumed it to be in the present instance, for the express purpose of showing the influence of the obliquity upon the bevels in that course. From these angles therefore, with the constant obliquity of 68 degrees, we derive the following construction for the case in question.



Let A E B in the subjoined drawing, represent the elevation of the given semicircular arch, of which C is the centre, and A B the span or diameter. At the centre C, make the angle A C D equal to 68 degrees the given obliquity, so that C D shall coincide with the axis of the arch, and point out the direction of the abutments to which it is parallel. From the beginning of the arch at A, set off successively the values of several arcs in the tables corresponding to the respective number of courses estimated from the impost at A to the crown of the arch at E, and from thence in a retrograde order to the other impost at B.

Upon A C the radius of the arch describe the semicircle A a b c C, intersecting the radii C 4, C 8 and C 12 respectively in the points a, b and c, and at A erect the perpendicular A D meeting C D the axis of the arch in D.

About A as a centre, with the distances A a, A b and A c, describe the arcs a f, b e and c d, meeting the radius A C in the points f, e and d respectively, and draw the straight lines D f, D e and D d: then are the angles A f D, A e D and A d D or their supplements, the angles contained between the face of the arch and the planes of the coursing joints at the 4th, 8th and 12th courses, or at the corresponding divisions on the opposite side of the arch. These are the angles corresponding to the letter B in the figure of the table of formulæ, and if they are respectively taken in the compasses and applied to a scale of chords, they will be found to indicate 81° 41′ 46″, 74° 46′ 25″ and 70° 6′ 59″.

Upon the straight line C D as a diameter describe the semicircle C g h i D, in which lay off the distances C i, C h and C g respectively equal to C a, C b and C c; then will the angles D C k, D C l and D C m or their supplements, be the bevels of the beds or coursing joints at the 4th, 8th and 12th divisions, or at the corresponding divisions on the opposite side of the arch; the bevels in the two cases being constantly the supplements of each other.

The angles just determined from the last step of the construction, are those which are measured by the arc a in the tabular figure, and if they are severally taken in the compasses and applied to a scale of chords, they will be found to indicate 69° 33′ 17″, 73° 55′ 12″ and 80° 23′ 16″ respectively, for the bevels in the beds or coursing joints corresponding to the 4th, 8th and 12th divisions of the arch.

The values of B, or the bevels between the face of the arch and the planes of the coursing joints at the specified divisions of the arch, are also determined from the 4th formula in that compartment of the table containing the values of B. Thus we have tan. B = tan. b cosec c, and taking the parts of the circumference at the respective divisions, we get as follows:

	°	′	″			
4th division	21	10	35 $\frac{5}{17}$	- - -	log. cosec.	0·442204
Value of b =	68	0	0	constant obliquity	log. tan.	0·393590
Value of B =	81	41	46	- - - -	log. tan.	0·835794
	°	′	″			
8th division	42	21	10 $\frac{10}{17}$	- - -	log. cosec.	0·171538
Value of b =	68	0	0	constant obliquity	log. tan.	0.393590
Value of B =	74	46	25	- - - -	log. tan.	0.565128
	°	′	″			
12th division	63	31	45 $_{17}$	- - -	log. cosec.	0·048098
Value of b =	68	0	0	constant obliquity	log. tan.	0·393590
Value of B =	70	6	59	- - - -	log. tan.	0·441688

For the values of a, or the bevels in the planes of the beds or coursing joints, the formula is cos. a = cos. b cos. c; and the operation is as follows:—

	°	′	″		
4th division	21	10	35 $\frac{4}{17}$	log. cos.	9·969637
Constant obliquity	68	0	0	log. cos.	9·573575
Value of a =	69	33	17	log. cos.	9·543212
	°	′	″		
8th division	42	21	10 $\frac{16}{17}$	log. cos.	9·868651
Constant obliquity	68	0	0	log. cos.	9·573575
Value of a =	73	55	42	log. cos.	9.442226
	°	′	″		
12th division	63	31	45 $\frac{16}{17}$	log. cos.	9·649080
Constant obliquity	68	0	0	log. cos.	9·573575
Value of a =	80	23	16	log. cos.	9·222655

We have limited the preceding construction and calculation to three courses only; this we have done for the purpose of saving room and preventing confusion in the figure; but from what has been effected, the reader will readily trace the method of procedure in any other case.

PROPOSED EMPLOYMENT OF VIBRATING CYLINDERS FOR THE LARGEST CLASS OF MARINE ENGINES.

THE compact form of the vibrating cylinder engine, its light weight, and the small section of the vessel which it occupies, together with the advantage of having the strain from the thrust or pull of the piston entirely within its own framing, and not partially transferred to the kelsons of the vessel, as is the case in the beam engine; seem to point it out as peculiarly applicable to steam navigation, and especially to those gigantic efforts which are now making to extend our intercourse with distant countries, where the advantage of having large power in small space cannot be too highly appreciated, as the various efforts of the most celebrated makers to effect that object sufficiently testify.

Various reasons however have been assigned why this form of engine should not succeed on a large scale, and these I shall endeavour to notice and refute.

1st. The great weight of the valve casing and slide on one side has been objected to as destroying the equilibrium of the cylinder, and wearing the cylinder and stuffing box unequally.

2d. The difficulty of casting the cylinder and hollow gudgeons sound, and the impossibility of repairing them in case of a failure.

3d. The disadvantage of passing the steam through the gudgeons at all, owing to the heat occasioning an unnecessary friction.

4th. The loss of power in communicating a vibrating motion to such a large body as the cylinder. And lastly, the difficulty of packing.

Now if the above named objections can be got over, which I think there will be little difficulty in doing, we shall then have an engine free from all the disadvantages of increased friction and short connecting rods; more compact in its form, and less exposed above the water line than any yet before the public, and consequently more eligible for the purpose of commerce or war.

To get rid then of the first objection, I propose to dispense with the slide altogether, and to substitute in its place four double-beat valves as used in the Cornish engines; one top and bottom of the cylinder on either side, two being steam and two exhaustion valves.

I conceive there are many advantages to be derived from this form and arrangement of the valves. Thus, the steam valves would also serve as expansion valves, as being independent of the others there would be no difficulty in shutting them at any point of the up or down stroke of the piston, affording us the opportunity of so adjusting them, as to avail ourselves to any desired extent of the principle of expansion. The exhaustion valves would have the same facility of adjustment, so that we should be enabled to open and shut the passage to the condenser at the point which would ensure the most effective working of the engine; such valves also afford great facility of repair; with the additional advantage of one man being able to handle both engines, although the cylinders were ten feet diameter, as such valves being almost balanced, lift or open, with the slightest exertion.

2d. I would cast the gudgeons on a separate circular frame, just large enough to encircle the cylinder and to which the cylinder should be securely bolted by a strong projecting flange; this would occupy a very little additional breadth, and would entirely get over that difficulty.

3rd. I do not know that passing the steam through the gudgeons is a serious evil, but at all events it can be very easily obviated.

Let the joint and stuff box be placed on the end of the gudgeon as usual, so as to be concentric and firmly secured, and let a flat pipe be carried up till sufficiently clear of the plummer-block cover, and then bent over and secured to the body of the cylinder, when it can be easily connected with either set of valves; by this arrangement the steam does not pass through the gudgeons at all.

4th. This I have often heard urged as an insuperable obstacle to the successful application of this form of engine, but when we consider that the working beams, crossheads, &c., in almost every case exceed the weight of the cylinder—further that the beams, crossheads, &c., must in all cases move through twice the space, and in many cases through three times the space of the vibrating cylinder for the same length of stroke, it will then appear plainly that this objection has no foundation, the loss of power from the same cause being evidently less than in a common engine.

The last objection, viz., the difficulty of packing, seems scarcely worth notice, as it has been perfectly overcome in numerous boats now running.

The stuffing box ought to be considerably deeper than in common engines, and the piston rod somewhat stronger.

The air pump, feed and bilge pumps can be easily worked from the intermediate shaft, as frequently done. But I should greatly prefer having a separate steam cylinder to work all those pumps, working in connection with and at pleasure, detachable from the main cylinders, this would get rid of the crank or eccentric on the intermediate shaft, which is to a certain degree objectionable. It might be so arranged as to be quite out of the reach of shot, and would not occupy any additional space on the floor of the vessel beyond that occupied by the engine framing; the following striking advantages would accrue from this arrangement; we should be enabled to keep up the steam and preserve s vacuum for any length of time, so as to start at a moment's notice; and secondly, what I consider of far greater importance, the turn of a cock, or opening of a valve might convert the air pump into an immense bilge pump, with an available power to work it, and sufficient to keep the vessel clear under almost any circumstances. The additional security to the shipowners, and safety to the passengers, which this would ensure in case of the vessel taking ground, or in other circumstances when it might be inconvenient or impossible to work the engines, cannot be too highly estimated; and I have no doubt there are many naval men who at one time or other would gladly have availed themselves of such a power. But if this arrangement be considered too decided an innovation, they can be worked in the usual manner.

In conclusion, I see no difficulty in the manufacture, nor any reason to apprehend a failure; and as such an engine would occupy not more than half the space of a common beam engine, would weigh very considerably less, and would, as before mentioned, be free from all the disadvantages of increased friction or short connecting rods, with the advantage of being less exposed above the water line; and lastly, could be made for quite as little, if not less expense; it is well worthy of the attention of the heads of our naval establishment, and of steam boat proprietors in general, and if there be any thing against it which I have overlooked, perhaps some of your numerous correspondents could point out where the fault lies.

A. S.

Pimlico, March 17, 1840.

TABLE OF ARCHITECTS WHO HAVE DIED IN THE 18TH AND 19TH CENTURIES.

By W. H. LEEDS.

IMPERFECT as the following Table is, *in tenui labor* might be its motto, since the drawing it up has cost far more pains and research than it ought to have done, or would have done, had not architectural biography been notoriously slighted. Relative to Italian architects and a few others of preceding periods, information may be met with in general biographical works, because the materials for such articles are abundantly supplied by Vasari, Baldinucci, and other writers of that class; but, with here and there an exception, such biography becomes more and more meagre, precisely when it might be expected to be more copious and satisfactory, namely, as we approach our own times. Not having the original work by Milizia to refer to, I do not precisely know which are the "Additional Lives," inserted by his English translator, but it certainly does not say much for either the diligence or judgment shown by her, when we find such names as those of Langhans, Antoine, and Ledoux omitted, while such a person as Joel Johnson, is deemed worthy of notice. The appendix to Quatremère de Quincy's "Vies des Architectes," gives a few notices of architects who lived in the two last centuries, yet in only one or two instances is there a date of any kind, which is certainly a more original than laudable mode of treating biography and history. Even Nagler's work, which professes to give notices of both living and deceased artists of every class, and which, when completed, will contain several thousand articles, makes no mention of Ginseppe Marvuglia, the architect of the beautiful Oratorio dell'Olivella, at Palermo, (given in Zanth and Hittorff's Archit. Mod. de la Sicile), nor have I been able to discover elsewhere any further mention of him, consequently, have no clue to even an approximating date for the time of his death. Though his journey was professedly an architectural one, Woods does not even mention the building at all; and indeed, as far as recent Italian architecture is concerned, the art might be supposed to be now altogether extinct in that country, judging from the dogged silence of all our later travellers and tourists in regard to it, for though some of them bore us with common Guide-book remarks on Palladio, scarcely one of them appears to have been aware of the existence of a Marvuglia, a Calderari, or a Cagnola, or of such living nobodies as Buonsignore, Bianchi, Canonica, Canina, and—not to go through the whole alphabet, numerous others, whose names ought now to be tolerably familiar to us here at home—at least to those engaged in architectural studies, and caring to be *au courant du jour* in the history of the art. What is still more extraordinary is, that where buildings are noticed, or even fully described as in Förster's Bauzeitung, there is frequently not either date or architect's name to assist the future historian.

As far as it goes, the present table affords a chronological synopsis that may be useful for reference, and for occasionally refreshing the memory. A similar one of buildings erected within the same period, might be drawn up as an accompaniment to, or skeleton of, architectural history during the last and present century; but it would be greatly more extensive, and in fact, there ought to be a separate table of the kind for each country. In the meanwhile, I am content to offer this specimen, and should any correspondent be able to suggest any additions, or fix any dates here left in uncertainty, I should feel obliged by his doing so.

CHRONOLOGICAL TABLE OF ARCHITECTS WHO DIED IN THE 18TH AND 19TH CENTURIES.

WHERE the precise date of an architect's death could not be ascertained, it is indicated by *ab.* (about). An asterish * is prefixed to the names of those who have distinguished themselves, not as architects, but as writers on architecture, &c. The names of places in Italics denote that the architect was chiefly employed there.

DIED.	NAME.	BORN.	WORKS.
1702	Bruce, Sir W.	..	Hopetown House, &c., Scotland.
1708	Mansard, J. Hardouin,	1747	
1714	Fontana, Carlo,	..	Palazzo di Monte Citorio, Palazzi Grimani, Bolognetti, &c., Rome.
	Schlüter, Andreas	1662	Sculpt. and Archit. The Dom, &c., Berlin. *Potzdam, St. Petersburgh.*
	Cayart, Louis	..	French Church, &c., Berlin.
1723	Wren, Sir Chr.	1632	St. Paul's; parts of Greenwich Hospital, &c. &c.
	Eosander, Joh. Fried., Baron von Goethe,	..	Monbijou, La Favorite, Charlottenburg, &c.
1724	Fischer von Erlach, Baron,	1650	Many churches and palaces, *Vienna.*
1725	Churriguera, Josef,	..	Celebrated as being the Borromini of Spain.
1726	Ardemans, Theod.	1664	*Aranjuez, Madrid.*
1727	Sir J. Vanbrugh,	1666	Blenheim, Castle Howard, parts of Greenwich Hospital, &c.
1728	Desgodets, Ant.	1653	"Antiq. of Rome."
1734	Campbell, Colin,	..	Wanstead House, Mereworth. "Vitruvius Britannicus."
1735	Cotte, Robert de,	1657	Chateau d'Eau, Hotel Toulouse, Façade of St. Roche, Paris.
1736	Juvara, Filippo,	1685	San Ildefonso, &c. *Lisbon.*
	Hawksmoor, Nich.	1666	St. Mary Woolnoth's, St. George's, Bloomsbury.
	Clarke, Dr. Geo.	1660	Library Christ Church, Oxford.
1737	Galilei, Alex.	1691	Corsini Chapel, &c. Rome.
1739	Galli da Bibiena, Fran.	1659	Theatre, Verona; Ditto, Vienna. "Architettura Maestra dell'Arti."
1740	Grahl, Joh. Fried.	1703	Several churches, mansions, &c., Berlin.
	Gabrielli, Gabriel,	1671	*Vienna, Eichstadt,* &c.
	Fischer von Erlach, Baron,	1680	*Vienna.*
1742	Gabriel, Jacques,	1667	*Bordeaux, Rennes, Paris.*
	James, John,	..	St. George's, Hanover Square.
1745	Bodt, Johann. de	1670	*Dresden.*
1746	Leoni, Giacomo,	..	Lyme Hall.
1747	Förster, —	..	*St. Petersburg, Cronstadt, Tzarkoeselo.* Edit. "Palladio."
1748	Kent, W.	1685	Holkham, Horse Guards, &c. Edit. "Inigo Jones' Designs."
	Gerlach, Phil.	1679	Buildings at Berlin and Potzdam.
1751	Salvi, Nicolo,	1699	Fountain of Trevi, Rome.
1752	Dintzenhofer, K. I.	1690	*Vienna;* several public buildiugs at Prague.
1753	Earl of Burlington,	..	Chiswick House; Assembly Rooms, York, &c.
	Baron von Knobelsdorff,	1697	Opera House Berlin. *Potsdam, Charlottenburg.*
1754	Gibbs, James,	1683	St. Martin's; Radcliffe Library, Oxford, &c.
	Wood, John,	..	Circus, Crescent, &c., Bath.
	Boffrand, Germ. de,	1673	*Paris, Nancy, Luneville.* "Principes d'Architecture."
1756	Villanueva, Diego,	..	*Madrid.* "Cartas Criticas," 1766.
1758	Ripley, Thomas,	..	Houghton Hall, Admiralty.
1759	Bonavia, Santiago,	..	*Aranjuez, Madrid.*
	Kleiner, Salomon,	1703	Designs and Engravings.
1760	Carlier, Fran.	..	Monastery de las Salesas, Madrid.
1762	Labelye, Charles,	..	Westminster Bridge.
ab.	Aifieri, Count Benedetto,	..	Opera House, and Teatro Carignano, Turin, &c.
1764	Sacchetti, Giambattista,	..	Royal Palace, Madrid.
	Murena, Carlo,	1713	*Rome,* &c.
	Burroughs, Sir James,	..	Senate House, Cambridge.
1766	Servandoni, Niccola,	1695	Façade of St. Sulpice, Paris.
	Ware, Isaac,	..	Footscray, &c. Edited "Palladio."
	Teodoli, Marq. Giacomo,	1677	Teatro Argentina, &c., Rome.
1767	Rubio, Felipe,	..	Custom House, Valencia, &c.
1768	Couvillier, Fran.	1698	Façade St. Cajetan's, &c., Munich.
	Dance, George,	..	Mansion House.
1771	*Woods, Robert,	1716	"Ruins of Palmyra."
	Zoccoli, Carlo,	1718	Cathedral, &c. Calvi; *Cutignano, Portici,* &c.

DIED.	NAME.	BORN.	WORKS.
	Kakorinov, Alex.	..	Academy of Arts, St. Petersburg, &c.
1772	Vanvitelli, Luigi,	..	Palace at Caserta, &c.
	Pompei, Count Alessandro,	..	Several palazzi at Verona; villa at Illasi.
1773	Blondel, Jacq. Fran.	1705	*Metz, Strasbourg, Cambray.* "Cours d'Archit." 9 vols.
1774	Preti, Franc. Maria,	1701	S. Liberale, &c., Castel Franco. "Elementi dell'Architettura."
	Galli da Bibiena, Anton.	..	Theatre at Bologna, &c.
1776	Boumann, Joh.	1706	Prince Henry's Palace, Catholic Church, &c., Berlin.
	Posi, Paolo,	1708	Palazzi Sergardi, and Bianchi, Sienna.
1777	Contant d'Ivry,	..	Began the Madelaine, Paris.
1778	Piranesi, Giamb.	1721	The complete collection of his Arch. Designs and Engravings, 15 vols. folio.
1779	Miazzi, Giov.	1699	S. Giambattista, Bassano, &c.
1780	Soufflot, Jacq. Germain,	1714	Pantheon at Paris.
	Fuga, Ferdinando,	1699	Palazzo Corsini, &c., Rome, *Naples*, &c.
1781	Simonetti, M. Aug.	..	The Museo Pio-Clementino in the Vatican.
	Schinkel, Karl Frederick,		
1782	Gabriel, J. A.	1710	Ecole Militaire,and Gardemeubles, Paris.
	Marquet, J,	..	*Aranjuez, Madrid.*
1783	Brown, Lancelot,	1716	Landscape Gard. and Architect. Claremont, &c. &c.
1784	Dieterichs, Fried. Wilhelm,	1702	Orangery, Potsdam; buildings at Berlin.
	*Essex, James,	1723	Several Essays relative to Gothic Architecture.
1785	Rodriguez, Ventura,	1717	The most celebrated of all modern Spanish architects: designed or executed an immense number of works.
	Peyre, M. Jos.	1730	One of the regenerators of French architecture. Odeon, Paris, &c.
1786	Fernandez, Miguel	..	Church and Convent de Montesa, Valencia.
1788	Stuart, James,	1713	"Antiquities of Athens." Chapel, Greenwich Hospital.
	Sir Robert Taylor,	1714	Parts of Bank of England.
ab.	Gontard, Carl von,	1738	*Berlin, Potsdam*, &c.
1789	Starov,	..	The Tauridan Palace, Church of the Alex. Newsky Convent, St. Petersburgh, &c.
	Paine, James,	1716	Mansion House, Doncaster; Wardour Castle; Worksop; Designs published.
	Temanza, Tommaso,	1705	Maddalena, Venice. "Lives of the Venetian Architects." 2 vols. 4to. 1777.
1790	Krubsacius, Fred. Aug.	1718	*Dresden.*
ab.	Knobel, Joh. Fried.	1724	*Warsaw, Grodno*, &c.
ab.	Boumann, Joh. Fried.	1737	Royal Library, Berlin; Theatre, Schwedt, &c.
1792	Adam, Rob.	1728	Register Office, &c., Edinburgh: Adelphi; Designs published.
	Gilabert, Ant.	1716	*Valencia.*
	*Ponz, Antonio,	1725	His "Viage de España," 18 vols., abounds with materials for history of Spanish architecture.
	*Moreno, Josef,	1748	"Viage a Constantinopla," &c.
1793	Sabatini, Franc.	1722	*Madrid, Aranjuez*, &c.
1794	Roncalli, Count,	1729	Custom-house, &c., Barcelona.
	Jean Radolphe, Perronet,	1708	Bridges at Neuilly, Mantes, Orleans, &c.
	Rodriguez, B. B.,	1736	*Madrid*, &c.
	Garcia, Josef,	1760	*Valencia*, &c.
1796	Sir W. Chambers,	1725	Somerset House; Buildings in Kew Gardens, &c. "Treatise on Civil Architecture."
1797	Duran, Ramon,	1760	*Madrid, Salamanca*, &c.
1798	De Wailly, Charles,	1729	Odeon at Paris; Saloon in Palazzo Serra, Genoa, &c.
	Gonsalez, Man. Reguera,	1731	Numerous buildings at Oviedo.
ab.	Cerati, Domenico,	..	New Hospital, Specola, and several Palazzi at Padua.
	*Milizia, Francisco,	1725	"Archit. Civile." "Vite degli Architetti, &c."
1799	Bazhenov, Vassil Ivanovitch,	1737	Mikhaelovsky Palace, &c., St. Petersburgh, Cronstadt, &c.
	Jardin, Nich. Hen.	1720	*Copenhagen.*
	Harsdorf,	1735	*Copenhagen.*
	*Weinlig	..	*Dresden.*
	Couture, Guill.	1732	La Madeleine, Paris, 1777-93.
1800	Sanchez, Franc.	1737	*Madrid, Minorca*, &c.
	Erdmannsdorff, Baron Fr. Wilh.	1736	Villa and Gardens, Wörlitz, &c.
	Tomas, Domingo de,	..	*Granada.* Finished the Façade of the Cathedral, Cadiz, &c.
	Louis	..	Theatre at Bordeaux, &c.

NINETEENTH CENTURY.

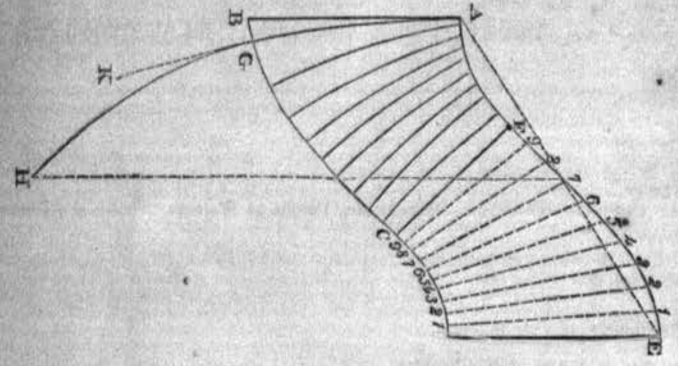
1801	Antoine, Jacques Denis,	1733	The Mint, Paris; ditto at Bern, &c.
	Sanz, Augustin,	1724	Santa Cruz, &c., *Zaragoza.*
1802	Gontard, Carl,	1738	*Berlin, Potsdam*, &c.
	Ivanov, Alexeivitch,	1760	*St. Petersburg.*
1803	Volkhov, Phedor Ivanovitch,	..	Tauridan Palace, &c., St. Petersburgh.
	Leroi, Dav.	1736	"Monumens de la Grèce."
1804	Calderari, Ottone,	1730	Several Palazzi, &c., at Vicenza. Designs published.
	Delagardette, C. M.	..	"Ruines de Pæstum." "Nouveau Vignole," &c.
	Revett, Nicholas,	1722	"Antiquities of Athens," with Stuart.
1805	Arnal, Juan Pedro,	1735	*Madrid.*
1806	Ledoux, Claude Nicholas,	1736	Barrieres at Paris, Hotel Thelusson, &c.
	Pollak, Leopoldo,	..	*Milan, Trieste*, &c.
	Holland, Henry,	1746	Carlton House, Old Drury Lane Theatre, &c.
	Renard,	1748	*Paris.*
1807	Mangin, Charles,	1721	*Paris*, &c.
	Carr, John,	1721	Harewood House, Yorkshire; Mausoleum at Wentworth, &c.
	Detournelle, Athanasius,	1766	"Grands Prix d'Archit." "Projets d'Archit."
1808	Bonomi, Joseph,	1739	Roseneath; alterations at Keddlestone, &c.

DIED.	NAME.	BORN.	WORKS.
1808	Piermarini, Ginseppe,	..	Teatro della Scala Milan, &c.
	*Gilly, David,	1748	Several works on Building and Architecture.
	Legrand, Jacq. Guill.	1743	Theatre Feydean, Paris. Many architectural works, &c.
	Langhans, C. G.	1733	Brandenburg Gate, &c., Berlin.
1809	Lechner, Joh. Bapt.	1758	*Munich.*
	Gebhard, J. Aug.	1735	*Dresden*, &c.
1810	Fischer, R. F. H,	1745	*Stuttgart*, *Hohenheim*, *Scharnhausen*, &c.
ab.	Dubut, L. A.	..	"Architecture Civile."
	Chalgrin, J. F. T.	1739	St. Philippe du Roule, Arch L'Etoile, &c., Paris.
1811	Genz, Heinrich,	..	Mint, Berlin, &c.
	Villanueva, Juan de,	1739	Teatro del Principe, Museum, Observatory, &c., Madrid.
	Mylne, Rob.	1734	Blackfriars' Bridge, Inverary Castle, &c.
1813	Brogniart,	..	Lycée Bourbon, Bourse, &c., Paris.
	Wyatt, Jas.	1746	Pantheon, Fonthill, Ashridge, &c. &c.
	Thomond, Thos.	1759	Great Theatre, and Exchange, St. Petersburgh.
	Gerstenberg, J. Lor. Jul.	..	
	*Houel, Jean,	1735	"Voyage Pittoresque en Sicile," 4 vols. folio, &c.
1814	Voronikhin And, Nik.	1760	The Kazan Cathedral, St. Petersburgh.
1816	Hardmuth, Joseph,	1752	Lichtenstein Palace, Vienna, &c. &c.
	Bianzani, Luige,	1756	Palazzi Fadigati and Cuti, Casal Maggiore: Church, Comasaggio; Villa Ala Ponzoni, Borgolieto, &c.
1817	Zanoja, Ginseppe,	..	Porta Nuova, Milan, &c.
	Quarenghi, Cav. Giacomo,	1744	*St. Petersburg*, *Tzarskoeselo.*
	Vici, Andrea,	1743	*Naples.*
1818	Dufourny, Leon, *ab.*	1760	Botanic School, Palermo, &c.
	Gondouin, Jacques,	1737	Ecole de Medecine, Paris.
	Selva, Antonio,	..	Teatro della Fenice, Venice.
1819	Catel, Ludwig,	..	Welpersche Badehaus; Orangery, Pankow; Decorations, Palace at Weimar. Several Architectural publications.
1820	Fischer, Karl,	1782	Theatre, &c., Munich.
	*Clerisseau, Chas. Louis,	1721	"Antiquités de Nismes," &c. &c.
1821	Rennie, John,	1761	Waterloo Bridge, &c.
1822	Damesme, Louis Em. Aimé,	1757	Theatre Olympique, &c., Paris.
	Giesel, J. Aug.	1751	*Dresden.*
1823	Porden, W.	..	Stables at Pavilion, Brighton; Eaton Hall, Cheshire.
	Rodriguez, M. Mart.	1746	*Madrid*, *Malaga*, *Salamanca.*
	*Genelli, Hans Christ,	..	Several publications on Architecture and Antiquities.
1824	Donnat, Jacques,	1745	Place Peyron, Toulouse; Allais Cathedral, &c.
	Hurtout,	1751	Restorations at Fontainbleau.
	Khumel,	..	Cathedral at Gran, Hungary.
	*Tappe, Wilh.	..	Writings on Architecture.
1825	Perez, Silvestre,	1767	*Madrid*, *Seville*, *S. Sebastian*, &c.
	Dance, George,	1741	Newgate, St. Luke's Hospital.
1826	Gandon, Jas.	..	Custom House, Exchange, Four Courts, &c., Dublin.
	Weinbrenner, Fred.	1766	Theatre, &c., Carlsruhe.
	*Friderici, Dan. Gottlob,	1767	Several publications, &c,, on Architecture.
	*Mazois, Fran.	..	"Pompeii." "Palais de Scaurus," &c.
1827	Engel, Franz.	1776	*Vienna.*
1829	*Cean-Bermudez, J. Aug,	1749	"Descripcion Artistica de la Catedral de Sevilla;" "Noticia de los Arquitectos de Espana," &c.
1831	*Hope, Thos.	1770	"Household Furniture;" "Costume of the Ancients;" "History of Architecture."
	*Melling, N.	1765	"Voyage Pittoresque de Constantinople," &c.
1832	*Pugin, Augustus,	1769	"Specimens of Goth. Archit." "Examples of Goth. Arch."
	Marq. de Guerchy,	..	Theatre de Vaudeville, &c., Paris.
	Gay, J. J.	1775	Museum, &c., Lyons.
1833	Cagnola, Luigi,	1760	Arco della Pace, &c. Milan, &c.
	Labarre,	..	Finished the Bourse, Paris.
	Thurmer, Jas.	1789	*Dresden.*
	Heigelin, Dr. K. M.	..	Prof. of Arch. Tubingen. "Lehrbuch der Höheren Baukunst," &c.
1834	*Cicognara, Count,	1767	"Fabbriche di Venezia." "Storia della Scultura," &c.
	Telford, Thomas,	1755	"Architecture," Brewster's Encyclopædia.
1835	Durand, J. Nic. Louis,	1760	"Leçons d'Architecture," &c.; "Parallèle."
	Nash, John,	..	Buckingham Palace; Pavilion, Brighton, &c.
	Goodwin, F.	1780	Town Hall, Manchester.
	Dufour, Alex.	1760	Restorations, &c., at Versailles.
1836	Heger, Franz.	1792	*Darmstadt.*
	*Stieglitz, Dr. Chr. Ludwig,	1756	"Hist. of Architecture," &c.
ab	Alavoine, —	..	July Column, Paris.
1837	Soane, Sir John,	1753	Bank of England, Board of Trade, &c.
	*Hirt, Aloysius,	1759	"Baukunst der Alten," &c.
	*Quaglio, Dominico,	1787	Distinguished Architectural Draftsman and Painter. Restored Schloss Hohenschwangen.
1838	Percier, Chas.	..	Arch. of the Tuileries. Restorations, &c., at Louvre and Tuilleries. Chapelle Expiatoire. "Recueil de Decorations," &c.
1839	*Landriani, Paulo,	1757	Scene-painter and Architect. "Treatise on Theatres."
	Ohlmulier, Daniel-Jos.	1791	Gothic Church, St. Maria Hilf, Munich.
	Valadier.	..	
	Wilkins, W.	..	Downing College, Cambridge; London University; National Gallery, &c.
1840	Wyattville, Sir Jeffrey,	1766	Additions at Windsor Castle.
	Albertolli, Giocondo,	1742	Still living in 1837. Villa Melzi, Bellagio; *Milan*, &c.

SKEW ARCHES.

SIR,—I am surprised that among the many correspondents who address you, there are so few of them either theoretical or practical, who touch upon the subject of skew arches, a subject which presents so wide a field of observation and remark.

Among the very few works which we possess on this point, Mr. Buck's seems to hold the highest place, although even in it there seems to me several things which would be the better for alteration or amendment. Although he is particular in giving the mathematical formula for calculating the necessary angles and lines, yet he assumes some things, as granted, which lie at the very foundation of his principles; for example, he observes that the lines of the courses of the intrados should be made perpendicular to a line drawn between the extremities of the developement of the face of the arch, without ever giving any reason for it, or making any remark on the subject, farther than that it should be so. Now it strikes me that a considerable alteration may be made in this for the better. Let A B C D E F (in the figure annexed) be the developement of a semicircular arch, then there is a curve A G H, such that a tangent drawn from any point in this curve is perpendicular to the face of the arch at the said point, as, the tangent G K, drawn from the point G is perpendicular to the developement of the face of the arch B, G C, at the said point G. Now if the courses were drawn similarly to this as shown in that part of the figure A, B, C, F, then the arch (according to Mr. Buck, in the beginning of his seventh chapter) would be perfectly secure. Unfortunately however, the difficulty of execution would be so great, if it is not an impossibility, that this could never be applied vigorously to practice, and the only way left is to make the best practicable approximation to this curve. There are two methods, either of which appear to me to be better than that of Mr. Buck's, although the first has a considerable drawback, because the beauty of the arch is very much destroyed on account of the unequal divisions of the courses. The first method is after having drawn a line as F C perpendicular to the face of the arch at the centre, to divide the segments F E, and C D into an equal convenient number of parts, and to draw the courses as shown by dotted lines from the one face to the other through the respective points 1, 1—2, 2—3, 3, &c. This, although a little more expensive than the common method, appears to me more desirable on account of the additional strength which it possesses. I may mention that I was shown a model built upon this principle, which when subjected to a pressure on the crown, forced the abutments asunder exactly in the line of the face of the arch, thus giving the best proof of the correctness of the principle. The second method which I would recommend is simply instead of drawing the line of the intradosal courses perpendicular to the straight line A E, to draw it nearly averaging the curve A G H, the tangent of the angle which such a line would form with the abutments approximates to $\frac{\cot\theta}{2}$. θ being the angle of the acute corner of the abutments. The advantages to be derived from this are, first that this angle being less than that commonly employed, there will be less tendency to slip, and secondly, that being more nearly perpendicular to the face of the arch, there is consequently more stability.



I am astonished at the serious errors into which Mr. Buck has fallen in his last chapter, which is devoted to *further investigations*, but which had better have been omitted altogether. In attempting to determine at what attitude above the level of the axis of the cylinder the thrust of the arch will be perpendicular to the bed of the voussoir, he gives a formula which produces the strange result that the smaller the archstone, the lower will be the said attitude, that is to say, the more secure will be the arch, and also that it will be able to be built at a more acute angle. Another still more strange phenomenon, the result of this formula, is that the greater the skew of the bridge the less of the arch will have to be supported by iron dowels and bolts; thus an arch built at an angle of 25° will require no assistance from dowels, an arch built at an angle of 55° will require to be secured by dowels to a height of 25° above the springing, and lastly, an arch of 90° or square to the abutments, will have to be secured to a height of 40° above the springing. The whole of these errors arise from having given the expression $\frac{\text{cosec.}\ \theta.\ \cos\tau}{\frac{1}{2}\pi}$ (nearly at the bottom of page 37), instead of $\frac{\cot\theta.\ \cos\tau}{\frac{1}{2}\pi} \div \text{cosine}\ (\theta+\phi)$ where ϕ is such an angle that its tangent is $= \frac{\cot\theta.\ \sin\tau.}{\frac{1}{2}\pi}$ This must be evident to any one who considers that the courses alter their angle with regard to the face of the arch, which Mr. Buck has not taken into consideration.

As it may be of some use to settle this problem, I would submit the following solution, observing that the letters and charaters refer to the same as in Mr. Buck's treatise.

1st. In finding a term for C O, I would reject the thickness of the cylinder, and consider the point O as that to which the tangents of the small curves which show in the face of the arch, tend; this is more correct because the joints of the voussoirs being segments of curves, there can be no point on the face of the arch at which a ball would roll down the bed into a line exactly parallel to the face; this may be considered too minute for observation, but besides being more correct it will simplify the question much.

Then upon this ground $\text{C O} = \frac{\cot^2\theta}{\frac{1}{2}}$, and taking Mr. Buck's own figures at the bottom of page 37. $\text{I E K} = \frac{\cot^2\theta + \nu.\ \sin\tau}{\nu.\ \cos\tau.\ \text{cosec}\ \theta}$.

2d. In finding the tangent of the internal angle, Mr. Buck states correctly "that the tangent of the angle, which the tangent of the intradosal spiral makes with the horizon diminishes as cos. τ," but he has omitted to mention that the angle θ, which the course makes with the face at the springing, increases as a certain function of sin. τ becoming $(\theta+\phi)$, where ϕ is such an angle that it has for a tangent $\frac{\cot.\ \theta.\ \sin.\ \tau}{\frac{1}{2}\pi}$; this then would make the tangent of the internal angle at the point sought $\frac{\cot\theta.\ \cos\tau}{\frac{1}{2}\pi.\ \cos(\theta+\phi)}$, then equating these values of the external and internal angles, we have

$$\frac{\cot\theta.\ \cos\tau}{\frac{1}{2}\pi.\ \cos(\theta+\phi)} = \frac{\frac{\cot^2\theta}{\frac{1}{2}\pi} + \nu.\ \sin\tau.}{\nu.\ \cos\tau.\ \text{cosec}\ \theta}$$

but rejecting ν in the second side of the equation, because by hypothesis it is unity, and multiplying both sides by $\frac{1}{2}\pi$, cos. τ, cosec θ, we have $\frac{\cot\theta.\ \cos^2\tau}{\sin\theta.\ \cos(\theta+\phi)} = \cot^2\theta + \frac{1}{2}\pi.\ \sin\tau.$

After this the solution must be completed by a series of approximations until a true value of τ can be found. If the thickness of the archstones is wished to be considered, then by making the second side of this last equation $\cot^2\theta.\ \frac{\nu+e}{\nu} + \frac{1}{2}\pi.\ \sin\tau.$ it will give the required result, thus,

$$\tau \text{ when C O} = \frac{\cot^2\theta}{\frac{1}{2}\pi}\,\nu, \text{ or } \tau \text{ when C O} = \frac{\cot^2\theta}{\frac{1}{2}\pi}.\ \nu + e,$$

	°		° ″		°
When θ is	60	then	40 56	- - -	40
	45	-	42 46	- - -	40
	30	-	50 10	- - -	43

The numbers in the last column are only approximations, but it may be taken that in all arches of a moderate skew, the point τ is about 40° above the level of the axis of the cylinder.

I have merely thrown out these observations for the purpose of directing attention to this particular kind of arch, which is now come into such common use, and about which we have so little information, and that little of a very loose kind with regard to the theory of the arch, but I think that Mr. Buck is entitled to the thanks of the profession for the clearness and accuracy with which he has explained and illustrated the greater portion of the subject practically considered.

I remain, Sir, your's respectfully,

B. H. B.

Edinburgh, March, 1840.

AMERICAN STEAM BOATS.

The following comparison of the power of the engines employed in the steam boats navigating the rivers of North America and those running here on the Thames may not be uninteresting to many of our readers, particularly those who are engaged in steam navigation.

We have taken as the basis of our calculations the following particulars of the "Rochester," a steam boat plying on the river Hudson, between New York and Albany, which have been furnished by Mr. David Stevenson in his "Sketch of the Civil Engineering of North America."

The Rochester is 209 feet 10 inches in length, and 24 feet beam, the depth of her hold is 8 feet 6 inches, and she draws, with an average number of passengers, 4 feet of water. The diameter of the paddle wheels is 24 feet, and the length of the floats, which are 24 in number on each wheel, is 10 feet, and their dip, under the above circumstance, 2 feet 6 inches. The vessel is propelled by one engine, having a cylinder 43 inches in diameter, with a 10 feet stroke. The steam, which is generated under a high pressure, is cut off at half stroke, and condensed.

Under ordinary circumstances the engine is worked by steam of from 25 to 30 lbs. pressure, and in this case the piston makes about 25 double strokes per minute; but when the Rochester is pitched against another vessel, and at her full speed, the steam is often carried as high as 45 lbs. on the square inch in the boiler, and the piston then makes 27 double strokes, or in other words, moves through a space of 540 feet per minute, or 6·13 miles an hour. In this case the circumference of the paddle wheels moves at the rate of 23·13 miles an hour.

It was under these circumstances that Mr. Stevenson made a passage in this vessel, during which he informs us she attained a speed of 16·55 miles an hour, her piston then making 27 double strokes per minute, and the tide being just on the turn; by which we judge the pressure of the steam in the boiler to have been 45 lbs. on the square inch. Mr. Stevenson remarks that "at that time the vessel could not be far from having attained the maximum speed at which her engines are capable of propelling her through the water." What the precise signification of this observation may be we do not exactly comprehend: the only way in which we can account for it is either that hard firing was carried nearly to the greatest extent possible in the furnaces, or that 45 lbs. on the square inch was not far from the highest pressure which the boiler was capable of sustaining without damage.

Allowing that at this great speed the steam is wire-drawn to such a degree as to lose 4·71 lbs. of its pressure (which is a much greater loss than is probably experienced in reality), we will assume the initial pressure of the steam in the cylinder to have been (including the pressure of the atmosphere) 55 lbs. on the square inch. The relative volume of steam of this pressure is 507·3, and as it is cut off at half stroke, its mean pressure through the stroke, reckoning the waste space at the end of the cylinder at $\frac{1}{20}$ of the contents of the cylinder, was 46·47 lbs. From this must be deducted the pressure in the condenser, which Mr. Stevenson estimates at 5 lbs. per square inch. This leaves a mean effective pressure of 41·47 lbs. per square inch, which multiplied by the area of the piston, which is 1452·2 square inches, gives 60222·73 lbs. for the total effective pressure on the surface of the piston, and multiplying this by its velocity 540, and dividing by 33000, we find the gross power to be 985·463 horse power. If we considered the pressure in the condenser as a part of the load of the engine, which would be the fairest way to show the comparative merits of different engines, since it is a defect when the pressure in the condenser is considerable, we should find the gross power of the Rochester's engines to be 1104·3 horse power.

Supposing the above data to be correct, the quantity of water boiled off to supply the engine must have been 5·9041 cubic feet per minute, or 354·246 cubic feet per hour.

Considering the Rochester's midship section as a rectangle, its area cannot exceed 96 square feet, and the power employed in propelling her at any given speed must bear some proportion to that area, depending on the form of her body. The power is also admitted to vary as the cube of the velocity; therefore the total power employed in propelling a certain vessel at a given speed may be represented by the expression

$$K A V^3,$$

in which K is a coefficient depending on the form of the vessel, A the area of her immersed midship section, and V her velocity.

The Gravesend steam boat "Ruby," belonging to the Diamond Company, is 155 feet in length, and her beam 19 feet. Her draught of water with 300 passengers on board was 4 feet 4 inches forward, and 4 feet 8 inches aft, mean 4 feet 6 inches, and the area of her midship section immersed 65·6 square feet. The diameter of her paddle wheels is 17 feet 2 inches, the number of floats on each wheel 14, their length 9 feet, depth 18 inches, and their dip under the above circumstances 20 inches.

The vessel is propelled by a pair of engines of 50 horse power each. The diameter of the cylinders is 40 inches, the length of stroke 3 feet 6 inches, pressure of steam in the boilers 3½ lbs. above the atmosphere, vacuum in the condensers 28¼ inches, number of revolutions per minute 31½, and speed of the vessel 13·5 miles per hour.

The area of the two pistons taken together is 2513·28 square inches, and the effective pressure of the steam on each square inch of the pistons is 3·5 + 13·852 lbs. = 17·352 lbs. which multiplied by the area of the pistons gives the total effective pressure = 43610·43 lbs., and multiplying this by the velocity of the pistons, which is 220·5 feet, and dividing by 33000, we find the gross power = 291·4 horse power. Or, considering the pressure in the condenser as a part of the load, as we did for the Rochester, the pressure on each square inch of the pistons being 3·5 + 14·71 = 18·21 lbs., we should find the gross power = 305·81 horse power. Of this gross power, which we will call P, a certain portion is employed in overcoming the friction of the engine and the resistance of the steam in the condenser, owing to the vacuum not being perfect; and we may assume this portion, in engines of the same construction and working on the same system, to bear a constant proportion to the gross power P. The remainder, which is employed solely in propelling the vessel, may therefore be represented by the expression $k\,P$, in which k is a constant coefficient.

We have shown above that this quantity may also be represented by

$$K' A' V'^3,$$

K′ being the coefficient of resistance of the Ruby, A′ her immersed midship section, and V′ her velocity. We must therefore have

$$k\,P = K' A' V'^3.$$

If P′ be the gross power required to propel a vessel of the same form as the Ruby, but whose midship section immersed is equal to that of the Rochester, or A, at the velocity V, which is that of the Rochester, we shall have

$$k\,P' = k\,P\,\frac{A\,V^3}{A'V'^3},$$

or

$$P' = P\,\frac{A\,V^3}{A'V'^3}.$$

Substituting the values of all the known quantities, we obtain

$$P' = 305{\cdot}81\,\frac{96 \times 16{\cdot}55^3}{65{\cdot}6 \times 13{\cdot}5^3} = 824{\cdot}54,$$

which is less than three quarters of the gross power of the Rochester's engine.

The effective power of the Ruby's engines, that is, the power applied to the paddle wheels, calculated from the resistance to the floats by Mr. Mornay's method given in Tredgold's Treatise on the steam engine, page 132 of the Appendix, but with double the coefficient, (Mr. Mornay having found since the publication of the above mentioned work, that the resistance to a body moving through a fluid should be double what the generally received theory makes it), is found to be equal to 267·86 horse power; but if we calculate their effective power by M. de Pambour's rule, which is to deduct from the effective pressure on the piston first 1 lb. per square inch for the friction without load, and then one-eighth of the remainder for the friction due to the load, we find only 240·285. The two methods would, however, give precisely the same result if the pressure in the boiler were 5·38 lbs. above the atmosphere; but it is probable there are some inaccuracies in the data of both calculations, and the discrepancy is not very great, the ratio of the two numbers obtained being very nearly 9 : 10. However, to give the Americans the advantage of every doubt, we will assume the pressure in the boilers to have been 5 lbs. on the square inch. (It would be unreasonable to allow more). In this case the gross power would be 331 horse power, and the disponible power by M. de Pambour's method, 262·315 horse power. The ratio of the latter to the gross power 331, or k, is thus equal to ·79249.

The gross power being assumed to be 331, instead of 305·81 horse power, makes P′, the gross power required to propel the larger vessel of the same form as the Ruby at the rate of 16·55 miles an hour 892·46 horse power, which multiplied by k, gives 707·27 for the disponible power required to be applied to the paddle wheels.

The amount of power absorbed by friction and other losses in the engines is thus, on the principle of the Ruby's engines 185·19 h. p., on that of the Rochester's 397·03 h. p.

So that the London engineers are not only capable of constructing engines which would propel vessels at the rate of 16·55 miles an hour (which has only been claimed for the Americans in one solitary instance), but they can obtain that result with less than nine-elevenths of the power employed by their transatlantic brethren.

It is however to be observed that the quantity of water boiled off, and consequently the expenditure of fuel would be greater in the English engines of 892·46 horse power in the American engines of 1104·3, owing to the steam in the latter being expanded in the cylinder; but it is evident that, by adopting the principle of expansion in the English engines, the saving of fuel would be in proportion to the saving of steam, and might be carried even much farther than in the engine of the Rochester.

ABSORBENT ARTESIAN WELLS.

By Hyde Clarke, Esq., C.E., F.L.S.

The plan of artesian wells for the supply of water, we have mainly derived from our neighbours the French, and it is one which has been frequently canvassed in your Journal. I have now to call the attention of your readers to another application of boring, which in the present advanced state of geological knowledge and mechanical science may perhaps be productive of some advantage here. It is that of absorbent artesian wells, or cesspools, a system successful on a small scale, but which I am not aware has been carried to the same extent as in France.

The following account of absorbent artesian wells at Paris is principally derived from the report hereafter referred to made to the Prefect of Police by M. Parent Duchatelet, the well known writer on hygienic police. The reasoning will apply equally to London, as the London basin is much the same as that of Paris, with the omission of the tertiary building-stones.

The city of Paris, for the purpose of suppressing the Laystall at Montfaucon, has within the last few years established a new one in the forest of Bandy. Although, this latter in 1839, received only a quarter of the soil daily supplied by the city, it occasioned, even at that period, great inconvenience both with regard to conveyance and dessiccation, on account of the existence of a stratum of water, the height of which, varying according to the season, often reached the level of its basin. A part of the fluid in excess might, it is true, have been turned into the little brooks, which spring up at a short distance, but as these brooks all run into larger streams and cross several villages and private properties, and indeed the town of St. Denis, would have caused just complaint on the part of a manufacturing population of ten or twelve thousand souls, for which the water is required to be extremely pure.

It was in order to surmount these difficulties that the contractors for the Bondy Laystall, stimulated by examples to which we shall hereafter have occasion to refer, thought of turning into the earth, at a considerable depth, the superfluities of their reservoirs. M. Mulot, C.E., was in consequence charged with the boring of an artesian well, intended, not for the purpose of bringing water to the surface of the earth, but to absorb that which should be sent down its shaft. This attempt was crowned with complete success; the boring having been carried to a total depth of 243 feet 7 inches, (74 m 71) showed two absorbing strata, one from 133 feet 5 inches to 155 feet 4 inches in a mixture of chalk and silex, and the other from 211 feet 11 inches to 243 feet, in argillaceous sand, and green and grey sands containing lignites and pulverised shells. By the first, 60 or 70 cubic yards were absorbed in four and twenty hours, and by the second 140 cubic yards in the same time.

The Prefect of Police, alarmed at the consequences which might arise, affecting the salubrity of the waters under the surface, from such a large mass of dirty fluids being mixed with them, ordered the process to be suspended until a committee of the Board of Health had examined into its operation.

In the Paris basin are several distinct strata of water, separated from each other by impermeable layers of different kinds. The first, that is to say the most superficial of these strata, is not to be found under the city of Paris; it is only met with on the tops of the hills and plateaux which surround it on all sides; it is retained by a thick bank of clay which is found above the masses worked as plaster quarries. For this reason, on these plateaux, 600 feet above the level of the Seine, the wells are often only two or three yards deep. This stratum is evidently formed by the filtration of rain, and by the condensation of vapour on the surface of the soil of the plateaux.

The second stratum, which probably depends on the same causes, but which extending under Paris and throughout the valley of the Seine near it, collects its waters from a much larger surface of country, and flows across sands which are between the plastic clay, and the building chalk (*calcaire à batir*, wanting in the London basin). It supplies all the wells in Paris, to the number of twenty-five or thirty thousand.

The strata of water below the two first can only be reached by boring; their number and the depth at which they are to be found vary to a great degree; sometimes they are entirely wanting, they do not always ascend, and if they reach the surface through the well, their overflow is not the same in places nearly contiguous. It is very important to be observed that these strata are so much the more abundant, as they are found at a greater depth, and that they have a rapid current, which gives them the character of subterranean rivers.

Numerous facts on the contrary prove evidently that the two first strata have no current, and are completely stagnant. The first, that which is above Paris, is very scanty, and there is a risk of infecting it by sending into it a large quantity of dirty water. To be convinced of this, it is enough to observe that the waters which came from the side of Mount Valerien are excellent, and those from Montmartre are not drinkable on account of the number of cowhouses and dung-pits which lose there all their liquid portions. The second stratum, that which supplies the wells of Paris, was formerly of good quality, and was used for drinking by the inhabitants of the houses, and neighbouring villages. It has only been since the increase of cesspools, and especially since the introduction of privies into houses, that is to say from the time of Francis the First, that the water has begun to deteriorate, and that the Seine water has been obliged to be used for drink. It must not, however, be thought that the influence of dirty and infecting waters extends beyond a very narrow boundary. Thus it has been found that around the great laystalls which were formed by the city of Paris near the barriers of Montreuil and Fourneaux, the well-water was never affected beyond a radius of 150 or 200 yards. The village of La Chapelle near Paris, not being able on account of its situation on depressed ground, to get rid of its dirty water, was obliged in order to disperse it to dig immense cesspools which swallow up all that is thrown into them. Besides a population of four thousand souls, the village of La Chapelle contains an enormous quantity of horses, cows, pigs, &c., and yet the wells near the cesspools have never been infected beyond two hundred yards from them. A still more decisive fact than the preceding is afforded by the history of the laystall of Montfaucon. Towards the close of the last century, before the conduit was made which discharges into the Seine, the surplus of the basins, one of the contractors for this laystall thought of digging in the lowest part a series of wells of large diameter, of which the bottom touched the stratum supplying the neighbouring wells. He succeeded by this means in getting rid of the troublesome water, and the wells around were infected, but not beyond a radius of 200 yards. A very long period is required to enable the gradual removal of water, by means of the alimentary stratum, to cleanse an infected well, of its bad qualities. A manufacturer in the Faubourgh St. Marceau wishing to get rid of the hot water of his steam engine at small expense, thought of sending it into a different well from that which fed his boiler. For some months this produced no inconvenience; but gradually the water in the neighbouring wells got warmed, and at last to such a degree that it could not be used for many purposes. The warm water was obliged to be sent in another direction; but it took *eighteen months* to bring the wells to their primitive temperature. We must add however, with regard to the gradual renewal of the water in the wells of Paris on account of the ever increasing consumption necessary for industrial purposes, that the suppression of the cesspools which the police no longer allow in the houses, and especially the establishment of moveable water closets, or at least with staunch walls, will prove so many causes which will probably in a few years carry off the bad qualities of the well water.

As to the lower strata, their abundance, and the rapidity of the currents which prevail in them, prevent us from assimilating them to wells, or from regarding the deperdition of dirty water, even in any very great quantity, as exercising a pernicious influence. In 1789, the architect Viel being employed by the Hospital Board to free Bicêtre from the rain and household water, as well as from the urine and fecal matters produced by a population of more than four thousand souls, he thought of directing the flow towards some old quarries deep enough to reach the stratum supplying the neighbouring wells. But wishing to have a permanent infiltration, he sought the second stratum by means of a well 15 yards deep from the bottom of the quarry, this well is ten yards broad at top, and ends in a bore of large dimensions, thus forming a cistern with which the several galleries of the quarry communicate. It was in the month of November, 1790, that all the water of Bicêtre was introduced into this cesspool, and from that day it has always run off easily. It is true that the wells situated on the right bank of the small river Bièvre, 150 or 200 yards from this cesspool, have been infected; but that arises from a circumstance purely local, rain water after storms, accumulating in the galleries, which communicate with the cesspool, and exercising an enormous pressure, cause the infiltrations to rise to the first stratum. For the purpose of remedying this serious inconvenience, the Hospital Board ordered a new absorbing well to be bored in a better position, which, since the year 1835, has absorbed 100 cubic yards of liquid, in twenty-four hours. Besides, the infection produced by the other did not extend to a great distance, for all the wells on the left bank of the Bievre, and the well of Bicetre itself, which is used for drinking by the population of the establishment, have never ceased to supply good water.

Notwithstanding the remarkable success attained at Bicetre ever since 1789, a considerable time elapsed before the boring of artesian wells was employed elsewhere for the dispersion of water, which have no drainage on the surface. A few years ago an artesian well having been bored on the Post Horse Square, at St. Denis, it was found that the waters, deprived of easy drainage, caused during frosts great impediment to traffic from the ice produced. This inconvenience had almost caused the plan for a new spring on the Place of Guelders to be abandoned, when M. Mulot engaged with the corporation to *disperse into the interior of the earth, when wanted, the waters brought to the surface after they had been used for such purposes as were required.* The new well was carried to the depth of 70 yards, and in the interior were arranged three concentric tubes like those of a telescope, with this difference that instead of there being any friction, they were separated from each other by a space four inches broad. The water supplied by the deepest stratum is brought to the surface through the interior of the smallest tube; the water of a stratum 60 yards deep is collected in the same way through the space between the smallest and the middling pipe; and the third tube, enclosing all the others, collects and disperses into the third (non-ascending) stratum the excess of water supplied by the two others.

A manufacturer of potatoe starch at Villetaneuse, a small village three miles from St. Denis, by means of an absorbing well, gets rid of the infected water, which had caused such serious complaints as would, very probably, have obliged him to have closed his establishment. The bore was carried to a depth of 70 yards, and during the winter of 1832 and 1833, the well carried off 80 or 90 cubic yards of liquid per day. After it had been in operation for five months, the borer carrying a scoop, with a valve at the end, was sent down, but, to the great surprise of the manufacturer and engineer, only brought up sand and whitish water. This fact, which shows so strikingly the rapidity of the lower currents, is enough completely to remove any fear which might be entertained of the inconvenience of dispersing among these currents such a quantity of infected water.

Relying upon the previous examples the Board of Health recommended the administration to leave the contractors of the Bondy laystall at perfect liberty, and accordingly every twenty-four hours a hundred cubic yards of liquid, charged with a considerable quantity of solid matter are dispersed into the absorbing wells.

An absorbing well constructed by M. Mulot for the city of Paris in 1835 at the Barriere de Combat, and also described in *Magasin Pittorsque* carries off a hundred cubic yards per hour. The contract price was £336 (8,400 fracns.)

M. Arago attributes the invention of absorbing wells, as well as of the ascending ones to the French. René, the famous King of Sicily and Count of Provence, had a number of cesspools dug near Marseilles, in the Plain of Paluns, a large marshy basin, which it seems impossible to drain by superficial canals. These holes throw and continue to throw into the permeable strata, lying at a certain depth, the waters which would render the country unproductive. It is said that the water absorbed by the cesspools of Paluns, after a subterranean course form the gushing springs of the Port of Mion, near Cassis. This is the most ancient example of the kind. These cesspools are called in Provensal, *embugs*.

The most important results are naturally expected from works of this nature, which it is anticipated will place new resources within the reach of the engineer. They will afford the means of draining marshes, which otherwise could only be cleared by difficult or expensive processes. The application to sewage is too evident to need inculcation, they will enable us to relieve many small streams, which receive the sewage of large and dense populations, and in every way they give to the engineer abundant promise of being able to contribute in various ways to the improvement of the public health. The extension of the system at Paris is proceeding rapidly, and it is to be hoped that it will be equally introduced in this metropolis, which lies in a similar geological position. The marshy districts of Hackney, Lambeth and Woolwich might be relieved, and instead of Mr. Martin's expensive plan for the improvement of the sewage, the Thames might be much more easily relieved by the filth being turned into absorbent wells. It may be believed that the dirty water becomes disinfected much more certainly, and so returned much sooner into circulation, by being dispersed in the under currents, than in the superficial waters.

CANDIDUS'S NOTE-BOOK.

FASCICULUS XIV.

> "I must have liberty
> Withal, as large a charter as the winds,
> To blow on whom I please."

I. It is said that Albert—or as some pretend he ought to be styled, 'His Majesty!' has a great deal of taste for all the fine arts;—and so, indeed, had George the Fourth, the misfortune was that it was—in architecture, at least, intolerably bad, as Buckingham Palace most plainly testifies. But let us hope better things of Albert,—that he will merit the epithet of *Kunstliebend*, and that he will exercise his influence in behalf of that art which most requires it—to wit, architecture. I trust he will have taste and to spare—for there will be many about him not overstocked with it; yet how people instantly discovered that he has such abundance of it, before he has done any thing to show it, is rather puzzling; except that they have taken it for granted, upon the principle that

> "All soldiers valour, all divines have grace,
> And maids of honour beauty—by their place."

and of course a Prince Consort must be a phœnix of taste and accomplishments,—a second admirable Crichton.

It will be well should his architectural taste induce him to keep his eye upon the new stables at Windsor, and to hint—in whatever quarter it may be necessary, that they ought to be something less disgraceful in design than the Mews behind Buckingham Palace. To say the truth, royalty appears to have been hitherto singularly unlucky in its choice of architects, in this country; which is all the more provoking because it is not Royalty but John Bull who has had to pay for the blunders and execrable designs of such persons as John Nash and Co.

II. However great architects may be in their own estimation, it would seem that they are little better than mere cyphers in that of the world,—such perfect nonentities that their names are of no importance. I lately met with a very florid description of the Prince of Orange's Palace at Brussels, according to which that building is one of extraordinary splendour and taste, yet who the architect was is not mentioned. Neither is such omission by any means uncommon; on the contrary, it seems to be *selon les regles*, and the giving an architect's name to be the exception to the rule. Dr. Granville for instance, not only speaks of the palace of the New University at Ghent, "which for chaste design combined with a rich and imposing style, yields the palm to few modern buildings, and is superior to any erected for the same purpose," but actually gives an elevation of its octastyle Corinthian portico; and yet does not consider it worth while to inform us who was the architect. Hundreds of other instances of the kind might be produced, even from works professedly on the subject of architecture. It may therefore be presumed that, unlike those of any other, the members of this profession are distinguished by a strange excess of modesty;—or if not, they must be grievously disappointed at finding that nobody cares to know even of their existence.

III. Architectural descriptions—or what profess to be such, are sometimes exceeding funny. In those accompanying Pugin's Views of Paris, and *done* by a French teacher named Ventouillac, we read of the front of a building being "adorned by two *perpendicular* ranges of columns," in addition to which curious information, we are assured that it resembles "Palladio's celebrated portico of the cathedral of Vicenza," the Basilica or Palazzo della Ragione of that city being blunderingly converted into a church. Poor Pugin was grievously annoyed at those and other instances of stupidity,—and no wonder; but the publisher was well satisfied that the work was done cheap, and nothing extra charged for such drolleries. It is not always, however, that they manage matters much better elsewhere, for turning over an Italian journal to-day, I met with some account of a book entitled "Quadro Storico dell' Architettura, dal Marchese Malespina di Sannazaro," where it is stated that St. Peter's was *begun* by Michael Angelo, and completed by his pupils and successors, among whom the principal one was Bramante!!—What a truly ingenious and delightful way of writing—or rather mystifying history! I know nothing to be compared to it except the following wicked bit of quiz: "Hannah More, the daughter the late of Sir Thomas More, who was beheaded in Utopia, was the author of Little's Amatory or Inflamatory Poems, to the infinite scandal of her worthy brother the present Sir Thomas, well-known in the religious world by his work entitled Practical Piety, and by another entitled "Cælebs in search of a Saint in petticoats,"—or this other, "The *Lousiad* of Camoens was written by Pindar the celebrated Greek poet, who lived in the reign of George III."

IV. There is a Finnish proverb which says, "Charming girls, lovely maidens!—where then do all the cross ugly wives come from?"—and which is not wholly inapplicable to architecture, since it is no less unaccountable where all the ugly, tasteless, paltry buildings and designs we behold, come from, when we read of the host of talent there has been and continues to be in the profession;—of the taste of such a man as James Wyatt, of the classical genius of Sir —— ——, of the imagination of John Nash;—or of the transcendent charms of any of those orthodox styles, which in our extreme affection for them we not only adopt, but generally take care to make our own by the patriotic process of Cockneyizing them into the bargain.

V. It is odd that though there are Doctors of Music, there should be no Doctors of Architecture. Perhaps it is because architecture is supposed to be in so sound and healthy a state as to require no doctoring. And yet, neither Mr. Joseph Gwilt, nor Mr. Welby Pugin seems to be of such opinion: on the contrary, both of them are for administering to it pretty strong cathartics. Surely they are entitled to add A. D., (*i. e.* not Anno Domini, but Architecturæ Doctor) to their names. There is also a certain scapegrace Candidus, who some will say, might be similarly distinguished, yet others may think he has far more of the Surgeon than the Doctor in his composition.—After all, perhaps it will be said that if Architecture has no Doctors, it has a tolerable number of Quacks.

VI. Vorherr, a living German architect, has a singular crotchet in regard to what he names *Sonnenbau*, which is that all sitting and sleeping rooms should invariably be made to face due South, having only staircases, passages, store-rooms and such places behind them. The reasons he adduces for it are satisfactory enough, and the chief objection to his scheme is that it is utterly impracticable, at least in towns: for supposing all the streets were made to run from East to West, and to be of such width that the shadow from the houses on the South side would never fall upon the opposite ones, it would be only these latter that would have their fronts, or at least their dwelling rooms facing the street, for the rest would have such rooms looking towards the garden or courts behind them—that is behind, as regards the street. This however I myself should consider no objection—rather a recommendation, because I could never understand what pleasure there is in standing at a window to stare or be stared at by your opposite neighbour. Indeed I should say that those houses would have the advantage whose sitting rooms were turned from the street, because they would not be exposed to the noise from carriages, &c. But then, unless the backs of those houses were made to correspond with the fronts of the opposite ones, the streets themselves would make a very strange appearance, presenting a row of fronts on one side, and irregular exteriors on the other. Besides which, much greater extent of frontage towards the street would be required for each house, as the houses must be long and shallow, in plan, instead of being as at present, narrow and deep. There is yet another difficulty standing in the way of such scheme, which is that were all the streets of a town made to run from East to West, there must be lines of communication between them from North to South, which according to such plan would be entirely between dead walls—that is, the ends of the houses in the streets, and the walls enclosing the gardens and courts, or whatever the intermediate space might be between the parallel rows of houses. I may therefore venture to say that *Sonnenbau* will, notwithstanding all its advantages, never come into fashion in London, even if it should anywhere else.

THE PATENT CONCRETE.

SIR—I have read an article in your Journal for the month of January last, describing the works in progress in her Majesty's Dock-yard at Woolwich, wherein it is said that the "*Patent Concrete of Mr. Ranger was found insufficient to keep down the Land Springs.*"

Although the assertion may be correct as far as relates to the work in question, viz., the dock which was constructed of that material, at Woolwich; yet, as such an assertion appears to question the efficiency of the patent concrete, I beg to state to you my decided opinion that the failure arose from a deficiency in quantity, and not from any defect in quality; from an improper manner of applying it—in fact, from a misdirected economy—the excavation being only lined as it were with concrete to form the bottom and the altars, instead of the earth being taken out of such dimensions as to admit of the concrete forming a solid spandril under the altars, (the back line of which should be perpendicular from the outside edge of the dock coping), and of having at least 7 feet in depth under the bottom of the dock. This will be better understood by the following figures.

These are not given as *correct* sections of the dock in question, but as diagrams sufficiently accurate to illustrate the accompanying observations.

Fig. 1.

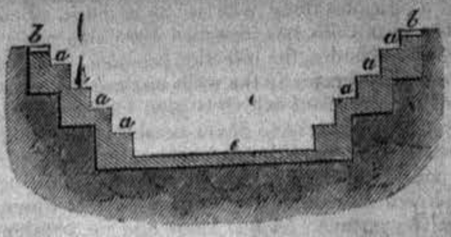


Fig. 2.

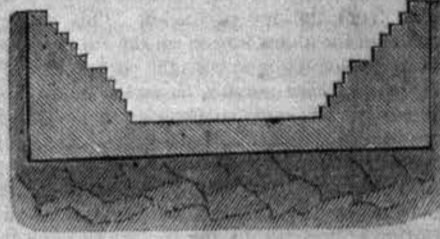


Figure 1 is a section of the dock as executed, where *a a*, &c. represent the altars, and *b b* the coping, the concrete at the bottom of the dock being about 2 feet 6 inches in thickness. By this figure it will be seen that unless the ground under the altars is of a very firm kind, such as good gravel, the weight of the concrete in the altars (being of equal specific gravity with Portland stone,) must cause a settlement, as they are in effect all overhanging, and the whole of the work, supposing each side to settle, (which may well be expected in such soil as that of Woolwich Dock-yard), would open somewhat similar to a book; and it is quite plain that any settlement of the altars would have an injurious effect upon the bottom, unless it was made of a depth much more considerable than it was in the present case, where the thickness was not more than one-third what it ought to have been.

Figure 2 shows the dock as I conceive it should have been constructed. Here it will be seen that the mass of concrete is about three times the sectional area of that in fig. 1, and I feel convinced that if this section had been adopted, no failure could possibly have taken place.

It may be here remarked, that in the construction of docks built of stone, the backing necessarily must form such a spandril as I have mentioned, and this is generally composed of bricks and cement; and why this solidity of form should have been departed from in the section of the dock in question, appears to be altogether inexplicable—and the more so when it is considered that Woolwich Yard is perhaps one of the very worst places in which so rash a step could have been hazarded.

With respect to land springs—I apprehend they may be expected generally to be troublesome in the progress of works in a Dock-yard, where the local pressure from high-water in tidal rivers, or from the sea, is calculated to increase the difficulty, so much so that the greatest ingenuity will sometimes be required to beat the enemy, even though granite and brickwork in cement be used.

I have lately seen a paper describing the method of treating springs as pursued by Mr. Ranger, at Chatham, where I find that gentleman ingeniously collected them by means of cast-iron chambers into pipes, and conveyed them into an adjacent culvert, by which they find their way into the Weir of the Dock-yard engine.

I have been led into these observations from an apprehension that the unqualified assertion, "the patent concrete was found insufficient to keep down the land springs," might be so conclusive to many persons who are not acquainted with its excellent qualities, as to prevent further inquiry upon the subject, and carry a conviction of its unfitness as a building material; while, on the other hand, I think that an examination of the subject will prove its peculiar applicability to the purposes of dock building, or any other massive work where the locality affords good gravel and lime.

At a future period I may return to this subject, and show the great economy of this material, as compared with granite and brickwork in cement; and I think it will not be difficult to show that two docks may be built of concrete, for one of granite and brickwork, and each of them equal in usefulness and stability, which must be considered a matter of no small moment in dock-yard economy at this period, when it appears so difficult to obtain from the rigid hands of our legislators, any adequate amount to be expended in those most important places.

I am, Sir, your obedient servant,

B. T.

Dublin, 14*th March*, 1840.

TOPHAM'S PATENT SLIDE-VALVE COCKS.

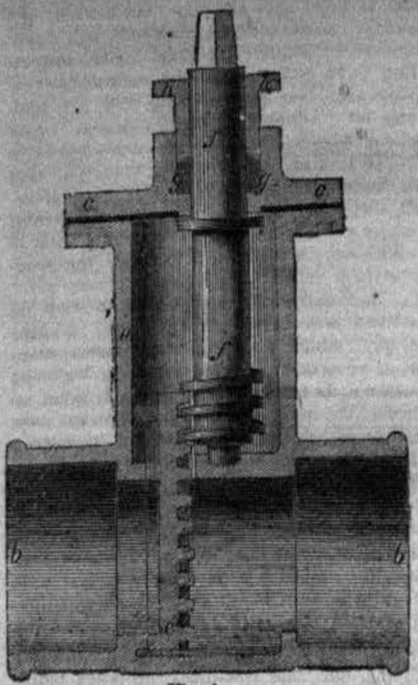


Fig. 1.

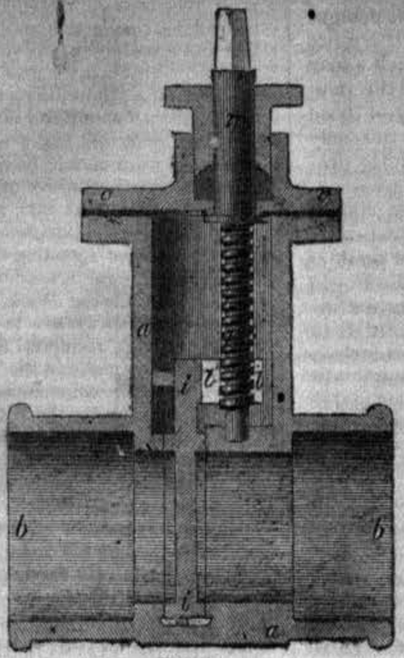


Fig. 2.

DESCRIPTION.

The outer case, in which the slide-valve is enclosed and worked, consists of a box, *a a*, with socket outlets, *b b*, cast in one, and a cap, *c c*, secured to the box by means of four wrought-iron bolts, the position shown at *d d d d*, in figures 1, 2, 3, and 4. Fig. 1 represents a vertical section of one form of the patent cocks, and fig. 2 is a plan of it with the cap off; *e e* is the slide with a rack cast upon the back of it; *f f* is a cast-iron spindle, with a screw cast upon it; *g g* is the stuffing-box; *h h* is the gland. This cock is intended only for what are termed *single*-faced cocks.

Fig. 3 is a vertical section of another form of the patent cocks, and fig. 4 is a plan of it with the cap off; *i i* is the slide with the double face, and with lugs, *k k*, cast upon it, to receive a female brass screw-nut, *l l*, and a wrought-iron square-threaded screw spindle, *m m*, as in the common double-faced screw cocks.

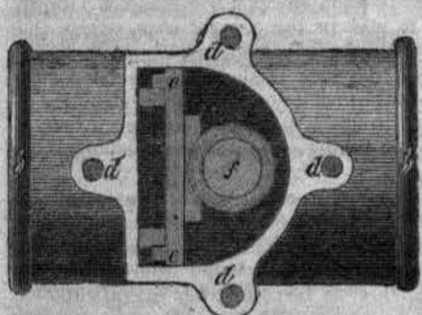


Fig. 3.

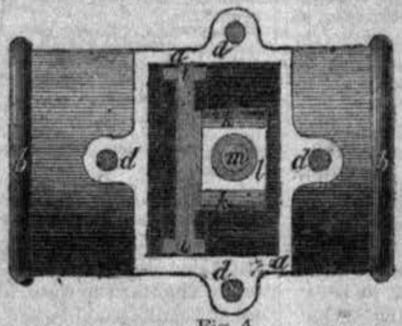


Fig. 4.

Observations.—In the screw cocks commonly used, the box is cast in two pieces, and the outlets are generally made with flanges, to which a socket and spigot piece with corresponding flanges are bolted. It is a well known fact that cast iron is not so liable to corrode as wrought iron, and therefore that dispensing with numerous bolts and three lead joints, will not only render the casing more durable, but enable it to be made at less cost. The side joints in the box or casing sometimes yield unequally; this prevents the slide shutting close to the face, thereby allowing the cock to "let by:" this is prevented by dispensing with the joint. Some cocks of the *smaller* sizes have heretofore been cast with spigot and socket instead of flange outlets; in the patent cocks, sockets are cast on both ends of *all* sizes; although it might originally have been supposed that by removing the cock, and leaving the flange, spigot and socket attached to the main or service, a new cock might have been introduced without breaking the main or service; *in practice*, when a new cock has to be introduced, the main or service *is* broken, and the junction formed by a double socket: it is therefore evident that the separate spigot and socket castings with flange joints are unnecessary. In the single-faced cock, the reason for introducing a cast iron screw and rack instead of a wrought iron screw, is that cast iron is less liable to corrosion than wrought iron, and therefore more durable.

The advantages of the patent cock are its simplicity and greater durability, (owing to there being fewer joints,) and cheapness. The facings of the cocks hereinbefore described are iron; if, from the nature of the water, cast iron is liable to corrode rapidly, the socket or sockets for single or double-faced cocks are made to screw in, and can therefore be faced with brass. The water supplied by the Water Works Companies in London, is of such a quality that *corrosion* of cast iron is very slow, and the extra expense of brass faces, or gun-metal screws, would be greater, when the interest of the money expended is taken into account, than the renewal of the cocks when rendered useless by corrosion.

Mr. Wicksteed, the engineer, has introduced these patent cocks into the services of the East London Water Works, and in a certificate dated Nov. 23, 1838, he states, that

"The chief difference between your patent cocks and those commonly used, consists in the body of the cock being cast in one, and the outlets in cocks of *all* sizes being cast on the body, instead of having flange, spigot and socket pipes attached thereto. By this means you undoubtedly not only dispense with the greatest portion of the lead-joints and screw bolts ordinarily required, and in consequence reduce the cost also, but the slide will be less liable to get out of its true working position, which it is apt to do from unequal yielding of the side-joints; and thus the necessity and expense of repairs, which have been rendered hitherto necessary, will be dispensed with. Although the application of the cast iron worm and rack may not be new, it is certainly not in general use: and, in single-faced cocks, may be used to great advantage. It will, in my opinion, be more durable, and is more simple, and less expensive, than the *wrought* iron screw spindle and *brass* screw nut.

"My experience inclines me to consider the use of brass facing in cocks, where Thames or River Lee water is used, unnecessary, as I know several cast iron sluice gates, with iron facings, that have been worked, and exposed to the action of these waters, for a period of nearly thirty years, that are now in as good a state as possible; the faces are not at all corroded, and the gates are water-tight. I therefore consider the use of brass, in such instances, as unnecessary and expensive. Nevertheless, should the water contain salts that would affect cast iron so as to injure the faces, the mode you propose in your specification, for facing with brass, appears to me well calculated for the purpose, without affecting the principle of dispensing with the side and other joints and bolts."

Mr. Wicksteed has furnished Mr. Topham with another testimonial of recent date, March 16, wherein he states, that

"After having used your patent cocks constantly for two years, I feel enabled to speak as highly of them as I did in my letter to you dated Nov. 23, 1838, and would strongly recommend their general adoption."

AMERICA.

INTERNAL IMPROVEMENTS AND PROSPECTS OF THE PROFESSION.

[The following article has been forwarded to us by our highly valued correspondent at New York, it was written for the American Railroad Journal, and is well deserving the perusal of the Engineers and *Government* of this country, many of the remarks are equally as applicable to the latter as they are to the American Government.]

THE attempt to form an Institution of Civil Engineers, has, we are sorry to say, failed. We are not, however, without hopes that another effort, more successful, will soon be made. We have heard a variety of opinions on this important project, and, earnestly as we desire its success, we must admit that there are difficulties in the way, which it is much easier to point out than to overcome. In the first place, it seems impossible to fix on any place where the leading members of the profession could meet even once a year, far less every week, as in London. The public works of the United States are scattered over such an immense extent of country, that there is probably no point where even half a dozen engineers, in charge of as many works, could meet even monthly. If we are right in this view, it is evident that the plan which succeeds so well in England, or rather in London, is not adapted without modification to this country. Then, again, the distinction between Members and Associates would lead to endless contention, though all will admit that some such division is both necessary and proper; but where to draw the line is the grand question. They who have held the rod, have carried the compass and level, have surveyed hundreds of miles for railroads and canals, and superintended the construction of not a few, are not pleased with the idea of being ranked with those who, having failed as lawyers, doctors, store-keepers, or office-hunters, "turn their attention," as the phrase is, to civil engineering, and who, in only too many instances, have at once received appointments to which they should have looked after five or six years arduous service in the field in the various grades of the profession. More than one of our readers could, without much difficulty, point out men in the situation of Residents, or even higher, who would be puzzled, if directed to take the goniometer into their own hands, and run out a curve of a given radius, to join two tangents given in position, while the same feat constitutes one of the very easiest duties of their assistants—the unpresuming title of those who do almost everything. There is a very large class of assistants in the United States who, from want of education, or subsequent aversion to study, or both, are unable to reach the highest stations of the profession, to which their long experience and practical skill fully entitle them. It is only when acting under men who combine liberal and scientific attainments with the proper experience, that this large class of eminently useful engineers can ever attain their deserts, and it does appear reasonable to suppose, that they would derive great advantages from a well-constituted Institution, where their industry, skill, and perseverance would be honourably registered by those who are alone capable of appreciating them. On the other hand, young men of superior talent or acquirements, have only to offer original communications to the Institution to be immediately known, and to be at once installed into the very position to which they are by their merits entitled, being neither ruined by injudicious flattery nor chilled by neglect. How different are the means by which a young engineer now seeks to rise in his profession, on the Government works, in which are included nearly all the works of this country. His political creed, and the number of votes he and his friends can command, would far outweigh the professional claims of a rival who might unite in himself the genius of all the engineers of the age; and this is the grand obstacle to the advancement of the profession in the United States.

We will briefly allude to the manner in which many works are "got up," more especially in the Western States. A "celebrated engineer" is employed to survey a railroad from 100 to 500 miles long; he makes a "highly favorable report" to the Legislature, on the strength of which they "authorise a loan," and "locate the line," though it is known to every well-informed man in the State, that the work cannot be put into operation for less than three or four times the original estimate, and when it is capable of demonstration, that the country cannot possibly furnish business enough to keep the work in repair and pay interest on the loans, far less pay anything towards diminishing the debt, until the population has increased at least ten fold—say in from 50 to 100 years. Now it is obvious, that such men as Walker, Brunel, Stephenson, and a host of others in England, and we are proud to say, not a few in this country, whom we do not feel ourselves at liberty to name, are found utterly impracticable in such cases, and they are consequently avoided with as much care by the projectors of works to be built on the credit of the government, as they are zealously sought for by those who project works to be executed by the expenditure of their own actual capital. The evil of employing men incompetent from want of education, practice and character eventually recoils on the State; hence the financial difficulties of all the States who have largely embarked in the construction of public works.

The State of New York furnishes some very instructive examples. By dint of much management a law was passed some years since, that, if a certain canal could be made for a million of dollars, it should be forthwith undertaken by the State. An engineer was immediately employed to survey the route, and he reported, that the work could be constructed for nine hundred and ninety odd thousand dollars, though this was only at the rate of one half the actual cost of a similar canal, presenting fewer engineering difficulties, which had just been completed. The insufficiency of the estimate must have been as well known then as now, still, the law had passed, and the engineer had reported "favorably," so the million was spent, and a million and a half more was then required to complete the canal in the cheapest manner. Three years after handing in an estimate for the enlargement of the Erie canal, the following reasons are given for requiring 100 per cent. additional. "A uniform plan" was not "adopted in the estimates," "and not much reflection had probably been bestowed on the particular manner in which the work should be done." It is also very properly observed, that frost is a very destructive agent in Northern climates, that a large canal requires stronger banks than a small one, and that work done in the winter costs more than in summer—all which would have readily suggested itself to individuals about spending their *own* money, even had it escaped the penetration of *their* engineers for two or three years.

Again, the Croton Water-works, nominally city works, though such no further than that the city pays for them, will contribute their mite towards developing the wonderful facility with which government engineers adapt professional opinions to the wishes of government commissioners. We must premise that the water commissioners had, till last year, delayed fixing on the plan for crossing the Harlem river, the most difficult and important work on the whole line. The plan then brought forward was opposed by certain proprietors of lands on the river, and the legislature decided unanimously against the commissioners, though the party to whom they owed their existence had a large majority in one branch—a case nearly unparalleled in New York legislation. The use of iron pipes for crossing, by means of an inverted syphon, the commissioners' plan, was unnecessary, with the high bridge prescribed by the Legislature, but, as the former are as averse to being interfered with as they are prone to interfere with others, they have announced their intention of complying with the law no further than absolutely necessary, that is, they will keep the aqueduct 12 ft. below grade and use the pipes. We quote their own words:

"The bill as revised, * * * is in substance as follows:—the aqueduct to be constructed over the Harlem river, with arches and piers, the arches in the channel of said river to be at least 80 feet span, and *not less* than 100 feet from high water mark to the under side of the arches at the crown.

"The original design of a high bridge, as designated in our report of January, 1838, required arches of 112 feet in the clear above high water mark, which is 12 feet more than that required by the Act of May, 1839. A bridge, therefore, of 100 feet height of arches above tide, will have to be passed by iron pipes or syphons, to accommodate the ascent and descent of the 12 feet from grade. This bridge will be more economical in its construction, and not subject to so many contingencies, from its less elevation, as the plan originally proposed. The parapets will only be 114 feet in height, which is 17 feet lower than the plan of 1838; and as the arches are thus reduced in height, stone of a diminished thickness may be used. It is proposed to carry the water over the river, at the commencement of supply, by two three-feet pipes, adopting the work, however, to carry two pipes of four feet diameter, when the city shall require it. *The same arrangement for pipe chambers, and waste cocks, will be required in this structure, as was required for the syphon bridge formerly proposed.*

The engineer echoes, "In relation to the bridge, the law prescribes that the arches in the channel *shall be* 100 feet at the under side of the crown, above common high water mark of the river, and *not less* than 80 feet span, conforming in these respects, we are at liberty to make the plans in all others, without restriction from the law.

The arches of the bridge originally designed to maintain the grade of the aqueduct, were elevated 112 feet above the high water mark of the river, which is 12 feet higher than the *Act requires.* It is obvious, therefore, that 100 feet will not be sufficient to maintain an aqueduct of masonry, but *will require* iron pipes as conduits for the water. This I do not consider an objection, as I am fully satisfied iron pipes will make the most suitable conduit for the water on such a bridge, and therefore have had a plan prepared, with a view to comply with the law, and avail of the economy and greater permanence from a less elevated structure. The less height required for the arches, and by adopting iron pipes for the conduit, the top of the parapets will be 114 feet above high water mark, which is 17 feet lower than the original plan. The superstructure being lighter than necessary for an aqueduct of masonry, a *diminished thickness* of arch stone may with equal safety be adopted."

We should be pleased to know what diminution in the depth of the arch-stones this change of plan would justify, as well as the saving in cost, which latter, we strongly suspect, it would be difficult to express in the constitutional currency of the United States, without an extension of decimals several places to the right of "mills."

The following extracts, though trifling in themselves, go far to show the estimation in which the profession is held by government commissioners.

"Notwithstanding the oversight of the inspectors and engineers, the work will, in a few cases, be carelessly performed; and it is only by the correcting influence of these repeated tours of inspection, made by the commissioners and principal engineers, that we can be certain the work is performed in a manner which will ensure its stability and imperviousness."

If the citizens of New York have no better guarantee than this, that the work has been faithfully superintended, that 4th of July on which the Croton water will be "regaling the taste and sight of our citizens," will be simultaneous with the millennium,

At p. 255, April number 1839, Railroad Journal, will be found the following cool assertion :

"The locks on the Chenango canal, which are 114 in number, are (with the exception of five stone locks) all of them composite. They were built under the direction of Mr. Bouck, one of the present canal commissioners, and their average cost was 3,808·50 dollars each."

We shall next be informed that the piers of the Potomac aqueduct have been successfully carried up under the direction of Mr. Forsyth, and that the Thames Tunnel has at length been completed under the superintendence of his prototype Lord Melbourne.

We refer to these circumstances only as effects of the policy of allowing the government to enter into the pursuits of individuals, and not with the design of insinuating that the mortifying reports of many government engineers are the *cause* of the present state of the profession, but simply to show that they are the legitimate consequences of the pernicious interference of the State Governments with that in which they have no more right to engage, than they have to establish theatres or hotels and then forbid any citizen from competing with them, on the miserable plea, that all the people of the State are interested in their tavern-keeping monopoly, that it bears equally on all, and is, to use the logic of governments, *therefore* just. The pecuniary difficulties in which most of the States who have engaged in railroad and canal speculations find themselves involved, will necessarily break down the entire system of State works, and their complete abandonment will, more than every thing else, conduce to the welfare, honour, and usefulness of the profession.

The success which has attended the expensive and well constructed railroads about Boston, is the most encouraging fact we have to record, and it is worthy of remark, that the stocks of those roads were the only stocks not affected by the bursting of the biennial bubble grandiloquently called the "late crisis." The Eastern railroad has been opened to Salem, and the number of passengers is already twice that estimated before the opening of the road, and on which the project was based. The Western railroad has been opened as far as Springfield. The Old Colony railroad is going on rapidly; the Norwich and Worcester is to be opened about new year's day, and the Housatonic railroad some time this month. In this State, the Utica and Syracuse railroad has been opened, and the Syracuse and Auburn railroad put into full operation. In Pennsylvania, the Reading railroad has just been completed, and in Maryland, we believe the Baltimore and Susquehannah railroad has been opened to the public. Two of the above roads have received aid from the State of Massachusetts, but they have all been managed, and, with these comparatively trifling exceptions, have been paid for, by individuals. *We do not know of a single State work having been completed, or in part opened, during the year* 1839.

In New England they have retained too much of the sturdy independence and common sense of their forefathers, to tolerate the meddling of the government in the affairs of individuals, and we seek in vain for a canal, a railway, a machine shop, a lumber or coal yard, owned by a New England State. It has been found impossible to persuade them that they are not as capable as their Transatlantic brethren of managing their own affairs, and the consequence is, that they have the best managed, best constructed, most costly and most successful, railways of any State in the Union. An attempt has been made to regulate the sale of spirits, and has proved about as successful as a previous effort to interfere with another article in the "grocery line"—y'clept "tea."

Some little has been done on the State works of New York, by means of the unexpended balances of former appropriations for the enlargement of the Erie canal, and the construction of the Genessee valley and Black River canals. There is no little curiosity to know how the first is to be disposed of—not only both parties, but every sane resident of the State, who feels an interest in her honour and welfare, being heartily ashamed of his credulity in believing it either practicable with the means of the State, or useful even if practicable. The money already thrown away on this unrivalled specimen of legislative folly, will do something towards opening the eyes of the citizens of this State, and a year or two hence we fully expect to find the enlargement as unpleasant a reminiscence in New York as the suspension is in a neighbouring State.

The lateral canals of the State of New York cannot with propriety be passed by, being "par excellence" government works in their conception, management, and income. As the official report on the Genessee valley canal has been published, we will examine the proceedings of the Commissioners with regard to that work, and our readers, by turning over their files, will be enabled to judge of the accuracy of our deductions. The original estimate of the canal was a little less than two millions, but the present estimate is thus stated in the report alluded to.

"The cost of the canal (excluding 314,520·43 dollars for the Dansville branch,) is estimated by the Canal Commissioners in their recent report, (Assembly Document of 1839, No. 360,) at 4,585,002·36 dollars.

"The canal board are not possessed of all the facts necessary to enable them to estimate with sufficient certainty the future revenues of the canal. They fully appreciate its value to the interesting section of the State whose resources will be developed by its completion. In respect, however, to the tolls to be derived from it in the present state of the navigation of the Alleghany river, the board would observe, that in the year 1835, F. C. Mills, Esq., the engineer who surveyed the route, submitted an estimate to the Canal Commissioners of its probable revenues, (Assem. Doc. of 1835, No. 264, page 42,) in which he computed the tolls, independent of its probable contributions to the Erie canal, at 39,129·60 dollars. Of this amount, 13,207 was estimated for the tolls on the finer qualities of lumber and other products of the forest, which, it was supposed, would seek the New York market in preference to that on the Ohio and Alleghany rivers. A majority of the Canal Commissioners, (including the late acting Commissioner on that canal,) in the report above referred to, have expressed their belief that the amount of 39,129·60 dollars, is "greater than will be realized for at least the first few years after the canal is completed."

Now let us translate this into plain unofficial English, such as is used in the every day transactions of common men, not devoid of common sense. It is proposed to construct a work at the expence of the State, the cost of which is estimated at two millions of dollars, and its *gross* income at less than 39,000, one third of it to be derived from lumber, which, it is well known, will soon be exhausted. The canal is to be 106 miles long, and we know from experience that 39,000 dollars will not meet the ordinary annual expenses, repairs and renewals. We will, however, suppose this sum sufficient for those purposes, then the people of this State are saddled with a "gentleman pensioner," who cannot exist on less than 100,000 dollars per annum. On comparing this, however, with the Chenango canal, it was discovered that the annual deficits of the latter exceeded those of the former by 20,000 dollars, and as the march of the Commissioners was "still onward," they at once decided on such an addition to the estimate as should place the Genessee valley canal as far "ahead" of the Chenango, as the latter was in advance of the other "auxiliary" canals. They determined accordingly on spending five millions on this work, which will entail on the State a permanent annual tax of 250,000 dollars at least.

Now, does any man, out of office, believe that the people of the State of New York would have authorised an expenditure of five millions of dollars on a canal which its friends and projectors assert will not yield more than 39,000 dollars gross revenue, merely for the privilege of having their money squandered by a set of Canal Commissioners? Before seriously entertaining such a project, far less recommending it, they ought to have been able clearly to establish the probability of an immediate income equal to

	Dollars.
Annual cost of repairs, renewals and expenses . .	50,000
Interest on five millions of dollars . . .	250,000
Towards paying off the debt, at least . . .	100,000
Making the total minimum income,	400,000

or ten times the estimated income, the latter being in fact, too insignificant in amount to have any material bearing in discussing the value of an undertaking which is to cost five millions.

Suppose that the State of New York, after expending one million on the Chenango canal, had refused to submit to any further imposition, that canal would be unfinished, its revenue nothing, in place of 20,000 dollars on an expenditure of two and a half millions, practically speaking, nothing; the State would have saved one and a half million, and would only have incurred a permanent annual tax of 50,000 dollars instead of 120,000 dollars, which the people of this State are now paying for the glory of owning the Chenango canal. We give an extract from an article which appeared in the Courier and Enquirer of 7th May last, in which the writer undertakes to prove that lateral canals generally will be nearly useless in themselves, and of little value to the main canal. Whatever may be thought of his *reasons*, it is only too true that his conclusions are fully borne out by the actual experience of this State.

"I have never seen any attempt to explain the causes which render the lateral canals unable to pay expenses, though it appears to me to be by no means difficult. The policy which led to the construction of these lateral or auxiliary canals, has no analogy with that which influenced and guided the projectors of the Erie and Champlain canals. The immediate object of the former, was to open to the husbandman the extensive and fertile region of western New York; that of the latter, to bring within reach of the city the forests of the North. Both have fully succeeded—not because there are no other such routes "in the world," but—because they were projected in such a manner as to open the greatest possible extent of country, and without reference to mere local interests. With the lateral canals the case is widely different, for it is evident, that the main canal will command the business of the country through which it passes, for a certain distance on each side, this in an agricultural country, will vary from 25 to 40 miles according to circumstances; but, whatever distance be allowed, it is clear, that the portion of the lateral canal contained within these limits, will only receive the contributions of those directly on its banks. If the lateral canals be from 80 to 100 miles apart, it will be found, by a few simple calculations of distances, that a very small portion of the country between the lateral canals, and within 40 miles of the main canal, will derive any advantage from the lateral canals. Hence the insignificant revenue of the Seneca, Crooked Lake, Chemung, and Chenango canals. The two first are in the country directly tributary to the Erie canal, one half of the Chenango canal is liable to the same objection, and the other half and the Chemung canal would suffer from the New York and Erie railroad, had they more than a nominal revenue. The Black River canal proper lies within the influence of the Erie canal, and its extension to the Lake or the St. Lawrence will only furnish a slower, more expensive, and more troublesome communication between its termini, than the present excellent one by Lake Ontario and the Oswego canal. Lastly, the Genessee Valley canal, with the Erie canal on the north, and the Erie railroad on the south, bids fair to be second only to the enlargement in disposing of the surplus revenue, or rather to the vast annual deficiencies, which nothing short of an entire change of policy can possibly avert. If the Black River and Genessee Valley canals, estimated at ten millions, be immediately abandoned, the State will lose about 500,000 dollars, which may be considered an anticipation of the payment of one year's deficiencies of these canals when completed, by the immediate forfeiture of which, the State will save a like expenditure per annum in perpetuity, besides the immediate disbursement of a sum nearly equal to the entire cost of the Erie and Champlain canals."

The estimates for these canals have since been reduced, and their probable deficiencies are estimated by Mr. Paige (Sen. Doc. 1839, No. 101, p. 7,) at 450,000 dollars, and if the sum now spent on these works does not exceed two millions, their immediate abandonment will save the State 350,000 dollars per annum—a sum more than sufficient to support the government. We shall have occasion again to refer to the above report, which contains the most sensible view of the public works owned by this state, which has fallen under our observation: and it derives great value from the circumstance that the writer is justly considered one of the ablest men of the party to which we are indebted for the lateral canals and the enlargement, and would naturally be disposed to treat them in the most favorable manner.

It is assumed by Mr. Verplanck and the committee of 1838, that the revenue of the Erie canal will justify an expenditure of 40 millions, and repay the principal in 30 years; while, on the other hand, Mr. Paige, from official documents, undertakes to prove that the revenue will only pay the interest on 15 millions, with every prospect of a permanent debt to that amount. This great discrepancy arises from the fact that Mr. V. adopted the views of the committee of '38, who state in their report,

"It will be perceived that the very foundation upon which the financial calculations of the committee are based, is the estimate of the Canal Commissioners submitted to the Legislature, in which they state that the Erie canal, within a few years after its enlargement, will produce an annual revenue of 3,000,000 dollars. The importance of verifying the accuracy of this estimate will be evident, as any material error would lead to the most injurious consequences."

Mr. Paige, on the other hand, instead of adopting the conclusions of the Commissioners, takes the data on which they either did or ought to have established their income of three millions, and demonstrates that there is no probability of the revenue of the Erie canal reaching this sum till the year 1886, without making any deduction for the partial or total repeal of its monopoly of carrying freight, on which exclusive privilege it was shown in a former number that its *entire surplus* revenue depends. The Governor in his late message, as well as the committees of '38 and '39, have placed implicit confidence in the estimated income of three millions, as reported by the Commissioners, while Mr. Paige goes to work as if he neither knew nor cared about any previous calculations on that subject. We have no means of ascertaining why he who knew the merits of the Commissioners so much better than the other gentlemen, should not have yielded the same credence to their statements; but, be this as it may, he has shown clearly that the estimate of three millions gross income from the Erie canal, is utterly unworthy of belief. We must, however, correct one error in this excellent report. It is said, (p. 8,) "The Commissioners cannot be regarded as estimating that the tolls would amount to 3,000,000 dollars in 1846 or 1849, but at a period much more remote." This unhappy attempt at exculpation had been anticipated by the report of the late Comptroller, which appeared more than three months before the report of Mr. Paige. This officer writes and italicizes the remark, (No. 4, Ass. Doc. p. 23,) "*A few years after the completion of the enlargement* may carry us to 1850." The door of escape for the Commissioners is therefore closed, and we are at liberty to choose, as we please,—Mr. Paige's estimate of three millions revenue in 1886, or the Commissioners' estimate of three millions revenue "*a few years*" before 1850.

After proving the inability of the State to complete the enlargement, and the consequent impropriety of any further expenditures, that same senator, the best lawyer in that body, advocates the enlargement, merely reducing the size from 7 by 70 to 6 by 60, a distinction without a difference—for an expenditure which is wrong in principle, cannot be justified by a diminution of its amount by four millions, or 16⅔ per cent, the precise amount leading to a long debate. The same course was also taken by another gentleman, who is well known for the manly stand he has taken against lateral, or, as he very properly designates them, "pauper canals," and thus we find two of the most able members of the Senate advocating a work which they know the State can never complete and can never require. As already remarked of the engineers, it is their misfortune rather than their fault, and the inevitable result of the departure of the government from the high duties of general legislation, and its illegal embarkation in the pursuits of individuals, for these same gentlemen, if members of a board of Directors who were expending *their own* money, would be eminent for sagacity, prudence, and candour.

The Governor in his first message admits the evil, but does not, in our opinion, go to the root of it, though, as it was necessarily written before entering on office, he could scarcely at that time have supposed it possible that he was approving of a system of works based on official data, which it is now only too clear, were never entitled to his confidence. He very truly observes,

"With the extension of our internal improvements there has been an immense and unlooked for enlargement of the financial operations and the official power and patronage of the Canal Commissioners and the Canal Board. These operations are conducted, and this power and patronage exercised and dispensed, with few of those requirements as to accountability and publicity enforced with scrupulous care in every other department of the government. So inconsistent and unequal are the best efforts to maintain simplicity, uniformity and accountability throughout the various departments, that a greatly mysterious and undefined power has thus grown up unobserved, while the public attention has exhausted itself in narrowly watching the action of more unimportant functionaries. It is a proposition worthy of consideration, whether greater economy and efficiency in the management of our present public works would not be secured, a wiser direction given to efforts for internal improvement throughout the State, and a more equal diffusion of its advantages be effected by constituting a board of internal improvements, to consist of one member from each senate district."

This plan may be attended with some advantages for a short period, but the very nature of the tenure renders it impossible for the State to command the services of agents with the character, capacity, and acquirements of those employed by individuals and companies, as is only too apparent in this State, from the manner in which the enlargement of the Erie canal, and the construction of the Genessee Valley and Black River canals have been "got up."

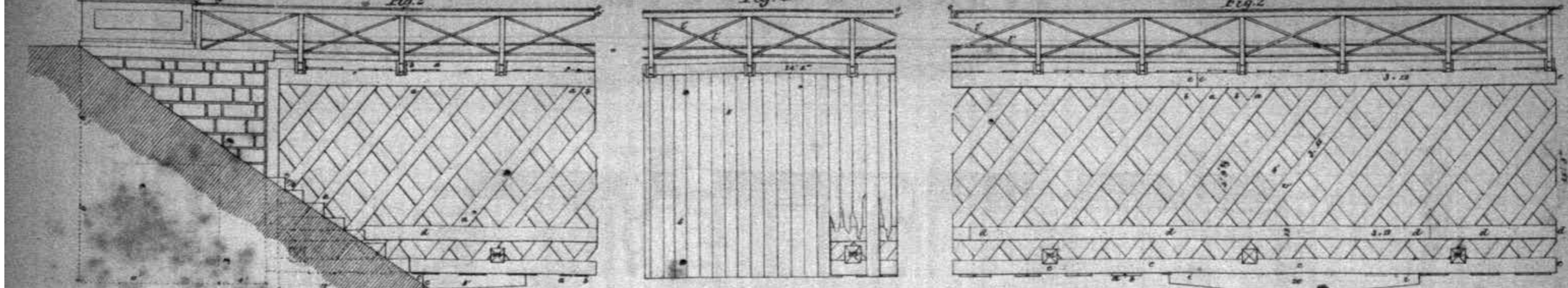
We will briefly allude to some of the Western States. In Michigan, a private company commenced the only important work which can, for many years, be projected in that peninsula—the Detroit and St. Joseph's railroad. The company, however, could not proceed with sufficient rapidity, so the State "assumed the mantle" of Engineer and Forwarder General, and commenced the construction of a "Northern Railroad," a "Southern Railroad," one on each side of the company's road, now the "Central Railroad," and rendered the *system* complete by introducing the "Clinton canal" between the northern and central lines of railway. These four works average very nearly 200 miles each, the sum appropriated or rather the loan authorized for these 800 miles was five millions of dollars, or 6,250 dollars per mile, about one fourth of the sum required to put them into operation, yet the State has actually entered on the construction of all these works. The result is, that the State, after expending all she has been able to borrow, has only 40 miles of the Central (formerly company's) road in operation, her credit is gone for many years, her farmers must be directly taxed to pay the interest on money expended on works which will never be completed, and the *only* work really required is indefinitely postponed. As in the State of New York, the works projected by the government of Michigan were never thought of by private companies, and it would be as difficult to raise by *private subscriptions* to the stock, 5 per cent. on the probable cost of the "Northern railway," of the "Southern railway," or of the "Clinton canal," as it would be to induce individuals in the State of New York to contribute, as a permanent investment from *their own* means, 2 per cent. towards aiding the government in the construction of the Genessee Valley and Black River canals, or in the enlargement of the Erie canal—that is, impossible.

The State of Illinois received from Congress a valuable grant of land to aid in the construction of the Illinois canal, a truly national work, uniting the Mississippi with the Atlantic by the St. Lawrence and Hudson rivers. This donation would have enabled the State to complete the canal, and the nett revenue might have been expended in aiding private enterprise without the possibility of any tax being necessary, even if all the works which they aided should be as unproductive as the "lateral canals" of New York. *Now* they have commenced a "system" of railroads, the aggregate length of which is above 1200 miles! besides other works. It is unnecessary to state the consequences which have followed, any further than to allude to the sale of the State stocks in New York at 50 per cent, and to the special session of the Legislature which has been called to devise "ways and means" to enable that State to meet its immediate obligations. There is much anxiety to know the course likely to be pursued by the governments of Pennsylvania, Illinois and Michigan, and last, though not least, the city of New York. The Croton water-works are exactly as far from completion as when ground was first broken, for the work which, with *any* quantity of money would require more time than *all the rest*, has just been commenced! Had the Commissioners invested the insignificant sum of 2 or 300,000 dollars from their *own* capital, this would never have occurred, and had this undertaking been left to a company, who should have been bound to expend 20 per cent. on the cost of the work from their *own* means, the citizens of New York would be supplied with "pure" water many years sooner, and at one third of the cost which now appears inevitable.

In some States the grand argument will be, that if they can only *complete* the works commenced, a revenue is immediately certain, which will render taxation to pay the interest unnecessary. That the completion of these projects will make the fortunes of many individuals, is well known, but, for the *permanent interests* of the State, the only plan is, to sell out at once with the present comparatively trifling loss. It is impossible to pay too much attention to the fact, that the greater part of the works projected by the governments of the different States, are not such as will ever be of any essential benefit, and when we add to this, that they are constructed at twice the cost of similar works in the hands of companies, are generally much inferior in execution, and always managed and repaired in the most inefficient manner

Bridge over the James River at Richmond in Virginia, United States of America.

Fig. 2.



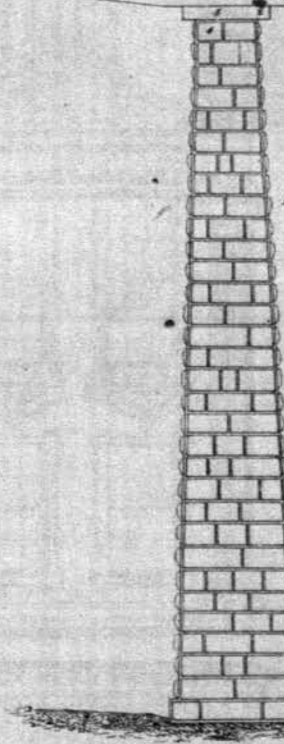


Fig. 4.

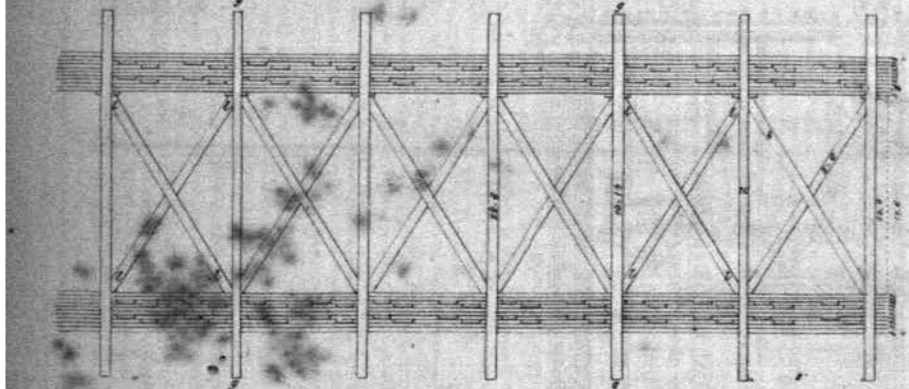


Fig. 6.

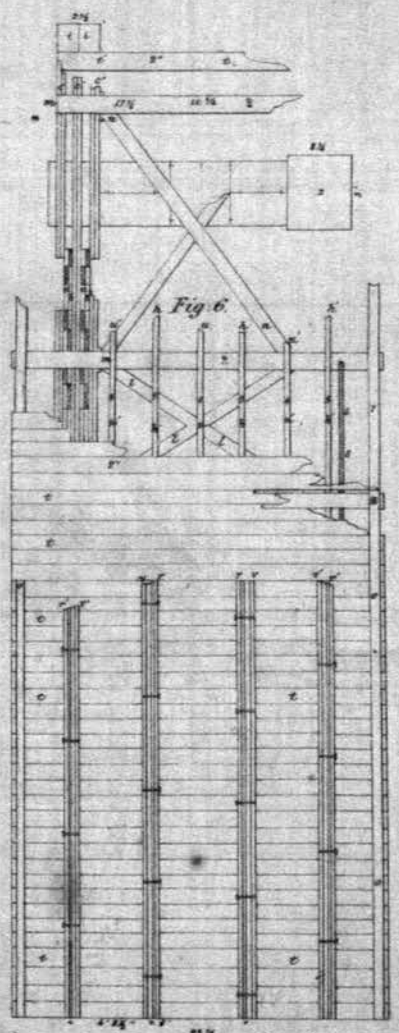


Fig. 3.

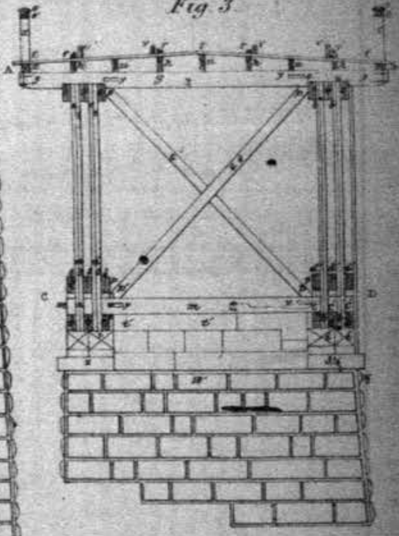


Fig. 5.

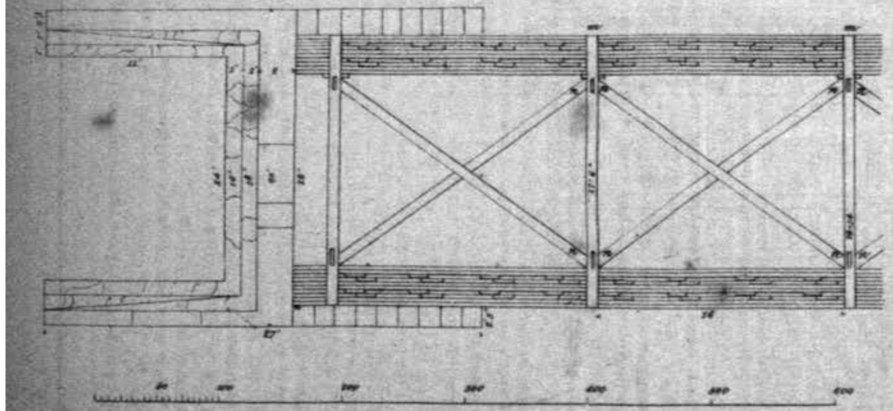
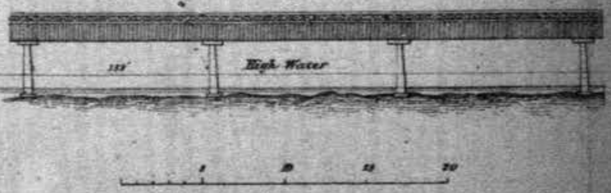


Fig. 1.



J. R. Jobbins, Warwick Court

—we shall be at no loss to account for the present condition of State works in general. The deficiencies of this year in Pennsylvania alone, are estimated at 1½ millions of dollars, and except the Erie canal, there is not a government work in the Union which has paid the ordinary expenses, including of course, interest on cost. If the Erie canal be placed on the footing of the canals of Pennsylvania, that is, if its exclusive right to carry all the freight to and from western New York, the western States and Upper Canada be abolished, the gross income of the canals of New York will bear a less proportion to the expenditures, than does the revenue of the public works of Pennsylvania to the annual outlays on the internal improvements of that commonwealth. Notwithstanding their financial embarrassments, we are happy to say, that no other State in the Union has resorted to this mode of giving a "delusive prosperity" to their public works, and there is some reason to believe that the long reign of "exclusive privileges" in this State is about to close. By making immediate arrangements for retiring from the construction of canals, the State of New York may yet escape with trifling loss, and with this object in view, the people would readily submit to the present monopoly of freight from the north and west for a few years longer. This appears to us the most judicious course to be pursued in order to avoid a permanent debt, and it certainly offers an honourable retreat from a position in which it is daily becoming more difficult to maintain ourselves.

The great efforts which have been made by the inhabitants on the line of the New York and Erie railroad, under the most discouraging circumstances, to aid in the construction of that undertaking, show that private enterprize is not yet extinguished in this State, and we have to record the astonishing and gratifying circumstance, that—notwithstanding the different State governments have made every exertion to absorb all the spare capital of this country and of Europe for their own Utopian schemes, the year 1839 has seen more works completed by *companies* than by *States*. Private energy and enterprise have succeeded where the power of government has been unequal to the task, and while the star of "free trade" floats triumphantly on the banners of the Bay State, and indeed throughout New England, we will not despair of seeing, in the Empire State, railways as judiciously projected, as well constructed, as profitable to the proprietors, and as useful to the public, as those of Massachusetts, when they shall be left equally free to the people of the former as they always have been to those of the latter State.

CN TRELLIS BRIDGES.

(With an Engraving, Plate VIII.*)*

We are principally indebted for this paper to a communication of Mr. Moncure Robinson in the *Revue Generale de l'Architecture.*

Mr. Ithiel Town of New Haven, an architect at New York invented a bridge of a peculiar construction which has much the appearance of a bridge invented here by the late Mr. Smart. The principle is one which has been adopted by Seppings in naval architecture. The advantages attributed to it are that bridges with openings of considerable span may be erected with small pieces of wood. These bridges are built on piers far apart and formed of a truss, if it may be so termed, of continuous trellis work, made of planks, double or treble, 10 or 12 inches wide, and 3 to 3½ inches thick, placed parallel to each other at an angle of about 45° to the horizon, crossing nearly at right angles, and alternating from right to left. The angle at which the trellises cross is not strictly a right angle, for the interstices form a kind of lozenge, which if three feet long would be about 2 feet 9 inches broad, which are about the general dimensions. At the crossings the planks are secured with pins. The bottom of the trellis work is strengthened on each side by string pieces running from one end of the bridge to the other, and made also of small pieces of timber 12 inches by 3, in lengths from 35 to 40 feet. The string pieces on each side of the trellis work are double, so that each trellis is secured by four pieces of timber, six inches thick on each side of the trellis. The joints being equally distributed throughout the length of the string piece. At the top of the trellis is a similar string piece running in the same manner the whole length. On the lower strings are placed the transverse beams which carry the timbers of the floor. The upper string piece in the bridges which were first constructed carried the roof.

The trellis work is secured at the crossings by pins of sound oak, an inch and a quarter thick, carefully turned on a mandrel. These pins fit neatly into holes previously bored. They are farther secured by a wedgelike pin driven into their centres on each side. This latter precaution is however only adopted on the more expensive bridges. These pins are two in number at the crossings, and four at the string pieces, they are the only means of securing the timbers to each other, as they are too thin to admit of framing. The only iron work in the whole bridge amounts to no more than a few nails and pins used in some of the joints.

Such was Mr. Town's original plan, and we shall now proceed to describe the improvements which have been subsequently introduced. It is evident that on this system the timbers of the floor may be laid either on the upper or lower part of the trellis work. By laying them on the lower part, the sides and roof may be more readily completed, but the other plan, which has been preferred for railways in the United States, admits of the carpentry being strengthened by horizontal and vertical braces, and gives additional security to the bridge. The ordinary wooden bridges, called in America Burr's bridges, after a carpenter of that name who improved them, are so elastic that the trains can only pass over them very slowly, while on good trellis bridges, particularly those made by Mr. Robinson, locomotives can run at full speed, a great advantage with regard to railways.

The height of the trellis depends on the strength required in the bridge, and necessarily increases with the opening or span. For extensive works where 200 feet span is required, the trellis is made 17 or 18 feet high. Mr. Town recommends that in most cases the height of the trellis should be a tenth or twelfth of the span. When the flooring rests on the string piece the height of the carriages will not admit of the trellis being less than 13 or 14 feet. Some of these bridges have been built of 220 feet span.

Throughout the timbering the two lines which present the greatest resistance are directed, one, following a horizontal right line lead by the lower extremity of the timbering; the other, following a curved arch, which rests by its two extremities on this right line. The trellis bridge has great strength at its base on account of the string piece formed of four pieces secured two and two; but it is not so strong along the upper curve described by the ideal line of the greatest thrust. The more the trellis is raised, the more the upper string piece, which strengthens the timbering, differs from this ideal line. It has therefore been observed that trellis bridges of large span are apt to settle; and once bent, they lose much of their strength. Mr. Town proposed several ways of remedying this inconvenience. To increase the resistance of the trellis, it may be doubled on each side of the bridge; this Mr. Town has tried, separating the pieces of which it is composed, so that the horizontal diagonal of the lozenge between four adjacent trusses should be four feet six inches, instead of three feet. This increases the cost of the wood of each side of the bridge 50 per cent., but on two-way bridges Mr. Town gets rid of the trellis work which he used to place between the two-ways, the quantity of wood remains the same. The string piece may be strenthened by repeating it at the crossing immediately above the pieces of the trellis. In the bridge at Richmond these two methods of strengthening the timbering have both been used. By laying the flooring on the top of the timbering, and by having open bridges, as previously observed, a means of preventing the settlement is obtained, by interior braces. Besides the weight of the roofing is got rid of, which is of little good for railways, where it would be more likely to catch fire from sparks. This danger is particularly to be feared in America, where wood is burned by the locomotives, and so more dangerous sparks are produced than from coke.

Trellis bridges are of the greatest use in the United States, because being formed of thin planking, they can be built in a short time. Thus, for instance, the viaduct by which the Philadelphia and Norristown Railway is carried over the Wissahiccon, 78 feet above the bed of the stream, and 483 feet long in three spans, was built in 68 days. For the same reason the wood required for the trellis work, being easily conveyed, costs less, in many cases, than that required by any other kind of wooden bridge. On the Pottsville and Sunbury Railway, in Pennsylvania, the wood for small truss bridges, for crossing roads is 12 dollars per 1000 feet super and inch thick, which is equivalent to two loads of timber in England. That for trellis work costs only 8½ dollars.

These bridges are formed of pieces all exactly on the same model and of the simplest form, so that all the trusses for the trellis work may be easily cut with exactness by ordinary mechanical means, and the holes bored for receiving the pins. The beams not being at all arched, but flat, it follows that the piers are not subjected to the lateral thrust, to which they are exposed in other bridges; and they only require a thickness necessary to resist the vertical pressure represented by the weight of the bridge.

Trellis bridges are very much increasing in use in the United States; a dozen years ago, one of 2200 feet length in ten spans was built over the Susquehannah, at Clarke's Ferry, near Duncan's Island, just above Harrisburg, the capital of Pennsylvania. One of 1530 long was built over the Hudson, at Troy, in the State of New York, for the railway from Troy to Ballston Spa. The chief spans are 180 feet. It is divided into two ways, each 15 feet wide, and separated by an additional trellis. It is made with the flooring at the bottom, and double trellises at each side. In 1835, others of great span existed at Newbury Port, Northampton and Springfield, all in Massachussetts, at Tuscaloosa in Alabama, at Providence, &c., and since then many more have been built.

The price of the timber for the Troy Bridge, including every thing but painting, is 18·25 dollars per foot. The piers are of fine blue limestone. The flooring is 30 feet above low water. The Tuscaloosa bridge is four spans of 220ft. each over the black Warrior River. The height of the trellis is 16ft. and it cost 6400*l*. It was opened in December 1834; and has stood well against the traffic which has passed over, particularly large herds of cattle. Another bridge of the same construction of large span is at Nashua, in New Hampshire, thrown over the Merrinack, The bridge across the great Conestogo to carry the Philadelphia and Columbia railway, as it formerly stood was 1412 feet long, and in nine spans of 150 feet. Its breadth was 22 feet, and the flooring rested on the string piece. This bridge was much too weak, the trains could run but slowly on it, and the trusses were only 2 inches thick, so that it has recently been obliged to be rebuilt.

Mr. Robinson prefers trellis bridges, and the many railways he has constructed to those of any other construction, and has introduced considerable improvements into them. That at Richmond is the most remarkable which he has built, and is distinguished as a first rate piece of carpentry, even in America where this mode of construction is carried to such perfection. This bridge stands without the town of Richmond,on the railway from that town to Petersburgh, forming part of the grand line from north to south through New York, Philadelphia, Baltimore, Washington, Fredricksburgh, Richmond, Petersburgh, Raleigh, and Charleston.

Bridge over the James River at Richmond in Virginia, United States.

This bridge was commenced in December 1836, and finished 5th September 1838, it was built by Mr. Sandford, under the directions of Mr. Robinson the engineer. It was erected a little below the magnificent cataract of the James River at Richmond, where the river is very broad, but not very deep flowing over the bare rock which forms an excellent foundation for the piers. The banks on each side of the river are very steep, which rendered it necessary to erect the bridge at a great height above the water.

The bridge is 2,844 feet long between the abutments, and contains 19 openings, which vary in their spans, one span is 130 feet, four 140 feet, four 150 feet, and ten 153 feet span from centre to centre of pier. The superstructure is entirely of timber, erected on the top of piers built of solid granite, rough scabbled on the face, and with rustic grooves at the joints; these piers are only 7 feet 6 inches thick by 21 feet long, on a level with the low water-mark, they batter all round to the top, which is 4 feet thick by 18 feet long on the plan; the height is 40 feet above low water-mark, and to the top of the rails is 20 feet more, making a total height of 60 feet.

Plate VII, fig. 1, is an elevation of the centre arches drawn to a very small scale.

Fig. 2 is an enlarged view of different parts of the elevation, showing the details of construction.

Fig. 3 is a transverse section of the carpentry.

Fig. 4 is a horizontal plan of the carpentry, one part exhibits the rails and floor, another part the joists, girders and wind braces.

Fig. 5 is a horizontal plan of the lower girders and wind braces, together with one of the abutments, and also the top of one of the piers.

The carpentry of the superstructure consists of a continuous double trellis work, 15ft. 6in. high on each side, and running from one end of the bridge to the other, with a triple string at the top and bottom, and another above the lower girders, each consists of two 3in. planks 12 inches deep. The trellis work is formed of 3in. planks 11 inches wide crossing each other and pinned together with two pins at each crossing, and with 4 pins at top and bottom to the string pieces. The whole thickness of the trellis work including the string pieces is 2ft. 6in. and the width between, under the roadway, is 12ft. 6in making a total width of 17ft. 6in. from outside to outside of the trellis work.

On the lower string pieces are placed transverse girders (tie beams) *m*, *m*, 14 by 10 inches, and 17ft. 6in. long and 16ft. apart from centre to centre; on the top of the trellis work are placed similar girders *g*, *g*, 22ft. 6in. long; the extremities of which are notched or caulked down to the top of the trellis work; upon the girders the joists are laid longitudinally, upon which is the flooring of planks inclined from the centre to the sides, the whole breadth of the top of the bridge is 23ft. 4in.

Upon the top of the floor are placed the rails, *r*, *r*, for two lines, they are of timber, 5 inches square, capped with an iron bar 2 inches wide by ½ inch thick, and for the the security of the trains, each rail is provided with a guard rail of a similar scantling, the guard rail at the bottom is in close contact with the rail, but at the top there is a space formed for the wheel, the width between the rails is 6 feet.

Between the upper and lower girders are fixed horizontal diagonal wind braces, *l l* which are morticed into them, there are also vertical diagonal braces, between the top and bottom girders, which render the whole of the bridge very stiff.

On the top of each pier are two capping stones 12 inches thick and 5 feet long by 3 feet 6 inches wide, which project over the pier 6 inches, on these stones are templates of timber to carry the trellis work.

The whole quantity of iron introduced in the bridge is less than a ton weight.

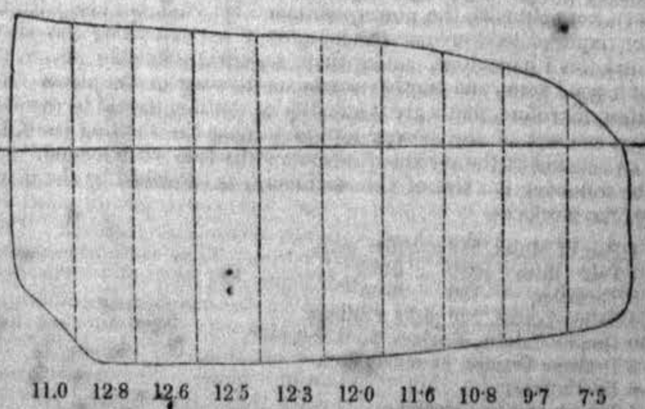
The following table of scantlings will explain together with the references and the drawings, the general construction of the bridge.

DESCRIPTION.	QUANTITY.	SCANTLING IN INCHES
Ribband for hand railing *o′ o′*	5,800 feet run	2 × 8
Cap ditto, *o o*	5,800 ditto	5 × 5
Posts ditto, *x x*	720 pieces 5 feet long, 5 × 5 and 5 × 8 mean	5 × 6½
Braces ditto, *l′ l′*	1,440 ditto 8 feet 6 in. long	2 × 5
Guard rails, *v v*	5,800 feet run	5 × 8
Ditto, *v′ v′*	5,800 ditto	5 × 10
Bearings rails, *r r*	5,800 ditto	3 × 5
Ditto, *r′ r′*	5,800 ditto	5 × 5
Flooring planks, *t t*, *t′ t′ t′*	67,200 feet super.	2 × 12
Flooring joists, *u u*	2,900 feet run	4 × 12
Ditto, *u′ u′*	5,800 ditto	4 × 10½
Ditto, *h h*	5,800 ditto	5 × 11⅓
Ditto, *h′ h′*	5,800 ditto	5 × 9
Ditto, *x′ x′*	5,500 ditto, in pieces 7 feet 7 inches long	7 × 7
Top girders, *g g*	360 pieces 22½ feet long	10 × 14
Top braces, *l l*	720 ditto 15 ditto	5 × 6
Chords or string pieces, *c*, *c′*, *c″*; *d*, *d′*, *d″*; *e*, *e′*, *e″*	2,850 ditto 36 ditto	3 × 12
Lattices, *a a*, *a′ a′*; *b b*, *b′ b′*	5,700 ditto 21½ ditto	3 × 11
Vertical braces, *p p*	360 ditto 18½ ditto	6 × 6
Bottom girders, *m m*	180 ditto 17½ ditto	10 × 14
Bottom braces, *n n*	360 ditto 20 ditto	5 × 8
Support timbers (templates) *ii*	80 ditto 20 ditto	18 × 18
Pieces to nail on weather-boarding, *s′ s′*	5,800 feet run	3 × 6
Weather-boarding, *s s*	95,000 feet super.	¾ × 12

PRACTICAL ILLUSTRATIONS OF THE METHOD OF INDICATING THE POWER EXERTED BY STEAM-ENGINES IN FACTORIES.

Sir,—In pursuance of this subject, perhaps I cannot do better than give detailed examples of cases in actual practice, as more likely to be of interest to practical men. With this view I have recently been furnished by a friend* with the annexed diagrams (Figs. 1 and 2),

Fig. 1.



Average 11·28 lbs. per circular inch.

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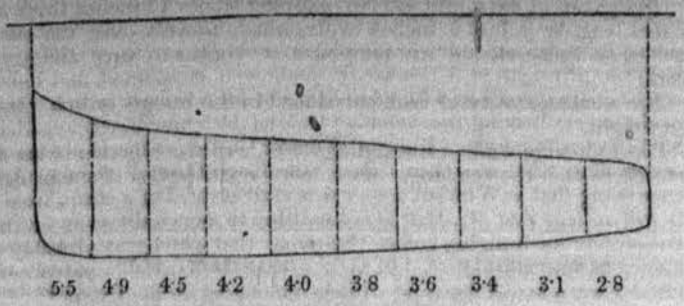
* A correspondent of your Journal, Mr. David W. Bowman, a young engineer of great promise, now on his way to South America.

Fig. 2.



Average 3·98 lbs. per circular inch.

together with an abridged extract from a report of an Indicator experiment made by him on one of Boulton and Watt's old 40 horse engines, now working in a cotton factory in Manchester, and also including some remarks thereon which seem pertinent to the subject of my last letter.

This engine has a cylinder 31½ inches diameter, 7 feet stroke, and a speed of 260 feet a minute. The diagrams were taken by Macnaught's Indicator, the scale of which is $\frac{1}{16}$ of an inch to each pound per square inch of pressure, or, which is the same thing, ·07854 of a pound per *circular* inch, the latter is the scale used, as it greatly abridges the calculation. Fig. 1 was taken when the whole of the machinery was at work in the usual way, and being measured, it gives an average for the gross pressure of 11·28 lbs. per circular inch. Fig. 2 was taken when the whole of the machinery was thrown off, the load of the engine then consisting only of the friction of the shafts, gearing, and straps running on the loose pulleys, together with the power required to work the engine itself. This figure, being measured, gives an average pressure of 3·98 lbs. per circular inch, for the friction of the engine, shafting, &c., which, deducted from the gross pressure, leaves 7·3 lbs. per circular inch for the net effective pressure.

The velocity of the piston, 260, drawn into the area of the cylinder, $31{\cdot}5^2$, (=992·25 circular inches,) =257,985, and this number, divided by 33,000, gives 7·8 horse power, for each pound pressure per circular inch. This, again, multiplied by the nett effective pressure as above found (7·3 lbs.) gives nearly 57 for the "nett effective indicated horse power" then exerted by the engine.

The following remarks are extracted from Mr. B.'s report:—"The power consumed by the shafting unloaded seems enormous, but as there is an immense quantity of it, and a number of the steps, I am told, are not in very good order, and the straps, too, being probably very tight, I am inclined to think that the result given by the indicator diagram is not far from the truth. This result, which is usually called *available power*, means all the power that is exerted by the engine, exclusive of what is absorbed by the engine, shafts and straps; but it would be a mistake, however, to suppose that all this available power is delivered (so to speak) at the machine pulleys, for as the work is put on, the friction is increased through all the ramifications of the shafting, and the amount of this increase, which we have no means of ascertaining, must be deducted from what is called the available power, if we wish to know the amount of power consumed by the *machinery alone*. It is a good practice, however, to debit the machinery, not only with the power consumed by itself, but also with the power required to overcome the increase of friction along the shafting, and this I have done, calling them together available power. It is not a good term, and another wants substituting in its place. It is manifest, therefore, that a great quantity of shafting should be avoided, both on account of the power lost in turning the shafting itself, but also on account of the *increased increase* of friction when loaded."

The following is a list of the machinery, as furnished by the manager of the works:—

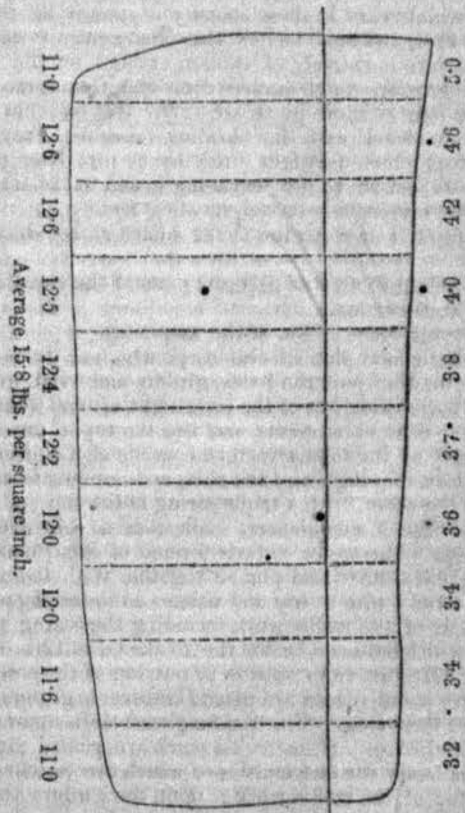
4 Pair of Mules, 648 spindles each.
1 Pair ditto 1080 ditto
8 Throstles 180 ditto
164 Calico Looms, 120 picks a minute.
60 Double Carding Engines, 50 inches each.
3 Drawing Frames, 14 rollers each.
6 Dyer's Frames.
1 Willow and Lap Machine.
Winding and Warping.
1 Mechanics Shop with Lathes and Grindstone.
63 Tape Looms, 25 pieces each.
11 Braiding Machines.
2 Tape Callenders.
1 Winding Machine.
2 Lathes and Grindstone.

Besides the above, there is a 9 inch pump 28 feet deep, which is included in the engine and shafting friction.

The remarks of Mr. Bowman bear evidence to the necessity of a nicer distinction in the technical terms used respecting the power of steam engines than has generally been admitted by engineers, and which necessity it was partly the object of my last letter to point out. The above list of machinery will also, I hope, be useful to mechanical engineers or others, who take an interest in the statistics of the steam engine. But I must observe that this engine must by no means be taken as an average specimen of the factory engines in Manchester; for as regards economy of steam, and consequently economy of fuel, it is considerably below that average. Indeed, I believe a worse case will not be easily found in any regular factory in Lancashire; and this is, in fact, one reason why I have selected it, for the serious consideration of those advocates of the expansive system who are continually boasting that the engines in Cornwall are doing five or six hundred per cent. more work for the same quantity of fuel than is done in any other part of the kingdom;* and also in order that there shall be no longer any mistake in this matter. Let any Cornish or other engineer point out clearly, how, even so little as 50 per cent. more work is to be done by the steam that the above engine uses, or a saving of one third of the fuel, and I know the owner of the engine will be very much obliged to him. I can find many factory owners that would be very glad to save even 10 per cent. in fuel at the present time, in addition, of course, to the ordinary interest of money for the capital required to be expended in adopting the improvement.

In the town of Manchester, owing to the difficulty of getting a sufficiency of cold water, the steam-engines are generally doing a much less duty than in the cotton-factory district surrounding it, where it is not uncommon to find them using about 6 pounds per horse per hour on the effective, or 9 lbs. on the nett effective indicated power. The diagram Fig. 3, which was sometime ago given me by my friend Mr.

Fig. 3.



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* In a Cornish newspaper now before me (called "Lean's Engine Reporter and Advertiser,") for November, 1839, is inserted an extract from the Athenæum, in which it is stated "that *five* times as much work has been done by a Cornish steam-engine as by an *excellent* Boulton and Watt's engine on the common system; or that the same amount of work is done with one fifth part of the expense of fuel! A statement *almost* incredible, yet perfectly true." It is, indeed, "almost incredible" to me, that the respected authors of the Monthly Reports should allow such assertions to pass without note or comment.

William Elsworth, of Preston, was taken by him from an engine belonging to Messrs. Horrockses, Miller and Co. of that town, working with about that rate of consumption. This engine is perhaps a fair average of the best engines in Lancashire, or such a one as might with propriety be compared to the average of those in Cornwall, whose duty is reported, in any question relating to the advantage and economy of the expansive system. I do not know the particular dimensions of this engine, but Mr. E informed me that it was then working at an effective indicated power of above 150 horses, which was about double its nominal power, as, indeed, appears evident from an inspection of the figure, which is measured by Macnaught's scale of $\frac{1}{16}$ of an inch for each lb. pressure per square inch, the vacuum averaging 11·99, and the steam 3·89, making a total gross pressure of nearly 16 lbs. per square inch. The temperature of the cold condensing water was 76°, and that of the hot well was 115°, at the time of the experiment.

I am, Sir, your obedient servant,
R. Armstrong.

Manchester, 14*th March*, 1840.

IMPROVEMENTS IN BIRMINGHAM,

With an Engraving Plate ix.

(From a Correspondent.)

Among many improvements which have lately taken place with reference to the public buildings of the town of Birmingham, are its magnificent Roman temple as a town hall, the grammer school, a splendid building in the Gothic style, the new churches, capacious market hall, railway stations, and several banking houses, all possessing architectural embellishments of no mean character, to these we may add Warwick house, the Drapery and Furnishing establishment of Mr. W. Holliday, just on the eve of completion, from the designs of Mr. W. Thomas, Architect. This building from its central situation in New-street its height, its extent of frontage, beauty of design and richness of detail may be justly entitled one of the ornaments of that improving town.

The annexed view is a perspective representation of the front as seen from the opposite side of the street, The design is in a style more than usually luxuriant, and the building occupies a frontage of 54ft 6in. in width and 55ft in height; the whole pile covering an area of 5,777ft. By reference to the engraving it will be seen that the shop front is divided into three compartments, by rusticated and empannelled ellongated Doric pedestals or pilasters of stone supporting coupled lions on each, the size of life; they carry the enriched entablature of the shop front, the part over the lions breaks forward and is likewise in stone with enriched modillions. The sashes are of massive brass, glazed with plate glass, the squares are in one height in single plates, the dimensions of which in the centre division are 11ft. 2in. by 3ft. 2in. and to the side division 11ft. 2in. The upper part of the building above the shop front is also divided into three divisions consisting of a centre and two wings, at the angles of the latter are antæ or fluted pilasters, and in the centre division are two three quarter fluted columns of the composite order, the height of two stories, (the example from the baths of Diocletian at Rome,) supporting an enriched entablature. Above is a very richly decorated attic with enriched panelled pilasters semi circular headed windows, ornamented with carved masks, and shells, the whole surmounted by an open scroll parapet over the wings, and carved panels in relief, representing foliated Griffins, masks, and foliage in the centre, with pedestals and acroteria. The interior of the building is fitted up with a corresponding degree of richness. It is 100 feet in depth and divided into three shops, the centre is the principal department, fitted up in a splendid manner. It is divided into compartments by marbled Corinthian columns and pilasters supporting enriched entablature and ceiling, at the extreme end there are similar columns and pilasters with a centre plate of looking glass, 10ft. 1in. high by 3ft. 6in. To the left is the furnishing department and to the right is the French department, connected with which is a cloak room furnished with a looking glass, 8ft. by 6ft. and a painted glass window 9ft. 3in. by 8ft. representing Trade, Commerce, &c. The fixtures are of riga oak. The back part of the building is lighted by lantherns, glazed with plate glass, the basement is occupied with warehouses, and in the upper part of the building are the dwellings for the proprietor and the numerous establishment.

THE PATENT WATER ELEVATOR.

Sir—I had a few days since an opportunity of examining a model of Hall's Patent Water Elevator, which appears calculated to overcome any difficulty in raising water to any required height at a very trifling cost; with the principle of it you are no doubt well acquainted, and I should not have troubled you with this letter but for a remark which a friend made on my naming the machine to him, he immediately recollected having seen some years since at Windsor Castle (as far as his memory serves him) what was then called "the Rope Pump," the only difference being that at Windsor a rope was used instead of a strap, from this it will appear that Mr. Hall is not entitled to any credit as an inventor, but merely for bringing before the public that which was probably only known to few individuals—In such a case is Mr. Hall's patent good? Or can any one use the rope without infringing on his patent?

I am, Mr. Editor,
Your faithful Friend,
An Original Subscriber.

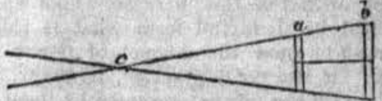
Leeds, March, 18, 1840.

⁂ We are decidedly of opinion that the use of the rope would not be an infringement of the patent. We are not very favorable to either the belt or the rope, as an economical mode of raising water. Editor.

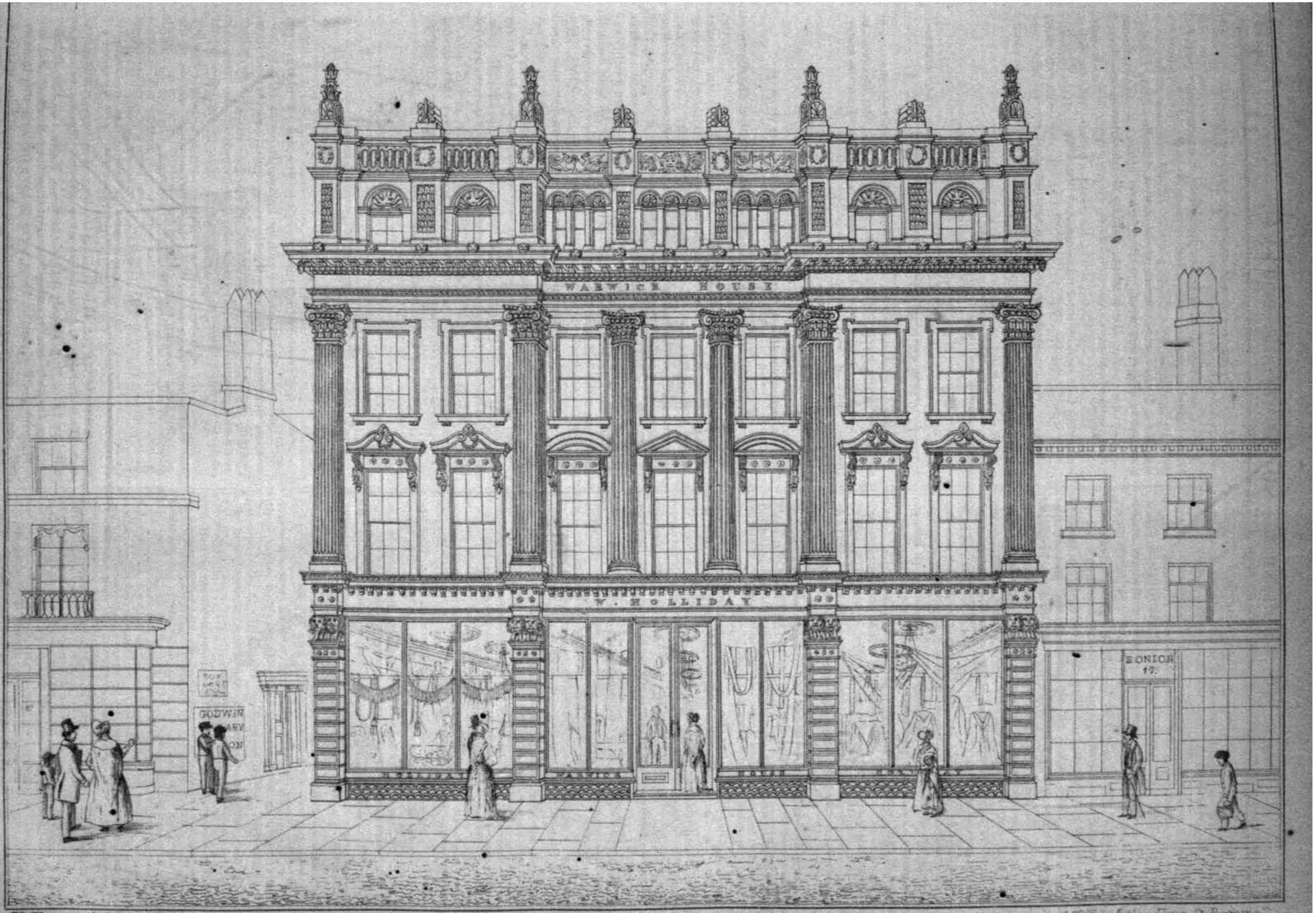
DR. LARDNER'S LECTURES ON RAILWAYS.

Sir—No doubt many of your readers have heard of the Lectures lately delivered at Liverpool and Manchester, by Dr. Lardner, "on the resistance to railway trains, the effects of gradients, and the general economy of steam power,"—he might have added a detailed statement of the profound ignorance of engineers on these points. Among other subjects he introduced that of conical wheels, and endeavoured to show that all engineers had fallen into an egregious error in supposing that the cone was of any service in enabling a carriage to move in a curvelinear direction, he said "never was there a more consummate mechanical blunder, the cone could do literary nothing; for they had left out of view the fact that the parallelism of the axles was preserved, and until they cease to be parallel the cone could do nothing. If a model carriage were constructed, with the wheels on one side small and on the other large, and the axles parallel, that carriage would not make so great a mechanical blunder as the engineers had done, &c."

Now, with all due deference, I must beg to dissent from the Doctor in his practical deductions: and I shall endeavour to show that the cone is practically the instrument by which carriages traverse curves. We know that if two wheels of unequal diameters be placed upon an axle and made to revolve, that the whole will describe a circle having for its centre that point where two lines drawn through the extremities of the diameters of the two wheels intersect thus.



c is the centre round which the pair of wheels *a* and *b* would revolve; and if there be another pair of wheels having the same relative proportions and their axle pointing to the same centre, and suppose these two pair of wheels to be connected by means of a carriage body, which would only slightly interfere with the conveyance of the axle, it is evident that the tendency of the wheels to move in the curve would exercise a force to preserve the condition necessary to do so; now my own impressions have always been that the tangential motion of the carriage would at first bring the outer wheel upon a diameter so much greater than the inner one, that its greater progression would exert a force sufficient to cause a deviation from parallelism in the axle which would suit the curve, the outer wheel will not slip unless the resistance to the axle assuming a convergence suitable to the curve, be about a $\frac{1}{4}$ of the insistent weight, which calling the weight of the carriage 5 tons would be $\frac{2800}{4}=700$lb. on each journal or wheel. The curves used on railways are seldom less than 1 mile radius. If we call the distance between the axle 10 feet, which is more than they generally are, and taking the width of rails at 5 feet, we shall have the deviation from parallelism of the axles in order to point to the centre of the curve $\frac{10}{5280}$ft. × 5ft. = 0·11in. and as they revolve in four bushes, which bushes are con-



W. Thomas Architect 1839.

G. Walker, Lithog Union St. Birmingm

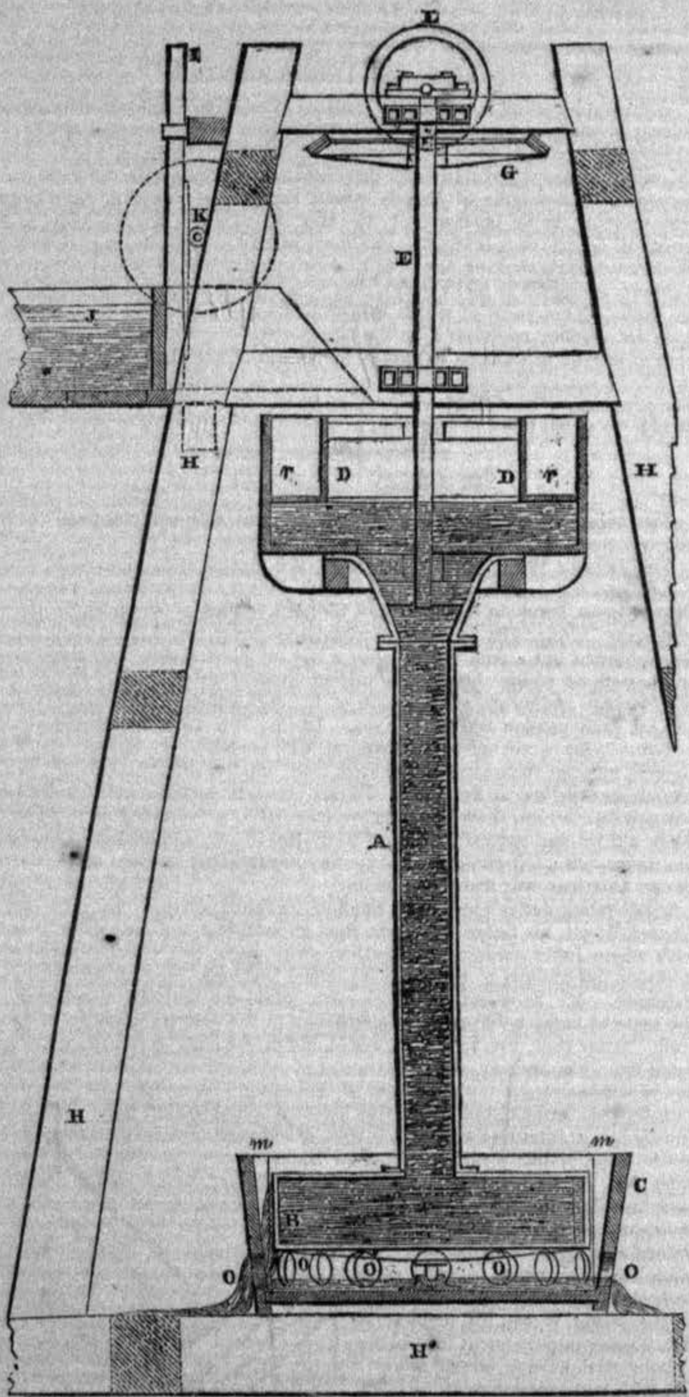
WARWICK HOUSE,
NEW STREET, BIRMINGHAM.

nected to the body of the carriage by means of springs, and kept in their places by guide plates, so that it is only necessary for the tendence to move in a curve to exert a force sufficient to alter the position of each journal, $\frac{11}{100}\times 4=\frac{11}{400}$ of an inch, in order to pass round a curve a mile radius solely by the influence of the cone, a quantity so small that the Doctor will find great difficulty in persuading practical men that it is "*impossible*" such a deviation can take place, more especially as we see a force equal to 700lbs endeavouring to produce it.

INQUIRER.

VERTICAL WATER-WHEEL.

Fig. 1.—Elevation.



THE accompanying engravings represent a vertical water-wheel, upon the principle of Barker's mill, which I erected at the iron-works of the United Mexican Mining Association at Durango, in Mexico, in 1832, for the purpose of driving a circular saw; it was desirable to produce a rapid movement without the intervention of gearing, and this not being possible by means of the breast wheel, which was, besides, fully loaded with the blast machinery, it occurred to me to avail myself of Barker's mill; I first formed a rough working model, upon the usual construction, but found the action of it so very feeble, that I surrounded the arms with boards, in order that the flowing water might impinge against them; this arrangement quadrupled the velocity of the machine: I then added the upper part, which was a still further improvement. The height of fall was about 8 feet, the bore of the pipe about 12 inches, the length of the legs about 30 inches from the centre, the size of the orifices about 6×2=12 square inches, the velocity 40 revolutions a minute; by the period it was completed and set to work, the works were suspended, so that nothing further was done with it; I had an ulterior object in view in constructing this machine, viz. to devise some simple and efficient means of working the "tahonas," or grinding mills used in the reduction of the silver ore in the mining districts; this wheel would have been in these cases invaluable, as it was formed entirely of timber, excepting the step or shaft, and the few bolts and hoops with which the tube and legs were bound together; it would never have got out of order, and could not have been broken by any, but a wilful accident; any country carpenter could make it, and keep it going, and it required noheavy or large timber in its construction, for it can be supported as well by a wall, as the timber framing shown in the drawing.

FIGURE 1 is an elevation, the wheel and water-course shown in section. Fig. 2, a plan of the upper wheel, and Fig. 3, a plan partly shown in section of the legs and tube.

The same letters refer to each figure, so far as the parts are shown in each. A is the vertical pipe, mounted on the box B, forming the legs, the water issues from each extremity, and impinges with great force against the fixed floats *n*, *n*, &c., of the fixed tub *c*, and ultimately escapes through the holes *o* cut in the bottom of the tub. Upon the upper end of the pipe a cross frame is fixed, which carries the horizontal or upper wheel, which has furnished all round its interior circumference vertical float-boards *r*, and horizontal floats *n*, which form cells, the water escaping into the tube through radiating openings left in the bottom as shown, thus advantage is taken of the momentum of the water rushing into the wheel. E is the vertical shaft, upon which the crown wheel G is hung, working the pinion L, which conveys the motion of the wheel, through the medium of its shaft, to the mill; J is the water and water channel, I the sluice, K the pinion to lift the sluice, H the framing by which the wheel is supported; the movement of the wheel is in the direction of the arrows shown in Fig. 2, and the reverse of those shown in Fig. 3.

Fig. 2.—Plan of Upper Wheel.

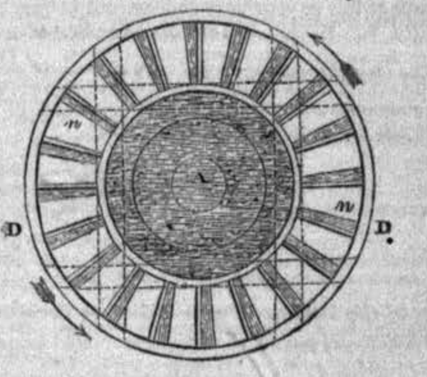
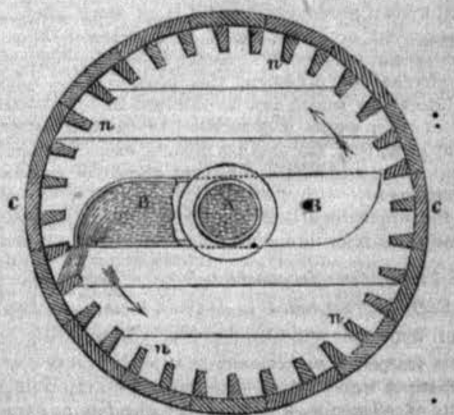


Fig. 3.—Plan partly shown in section.



15, *Stamford Street.* W. J. CURTIS.

COMPETITION DESIGNS.

SIR—Observing in your Journal of this month, a communication from Mr. Wyatt, which contains a correspondence between Messrs. Wyatt and Brandon and the Committee for building the proposed New Church at Cardiff, wherein my name is frequently introduced, I feel called upon in justice to my own professional character, to offer the following explanation, by which I think Messrs. W. and B. will be induced to view the circumstance in a different light to that in which they now regard it.

The first fact which I shall allude to, in order to remove any impression that may exist, as to my plan having been selected from personal preference, is, that I was an entire stranger to every one of the committee until after the adoption of my design had been determined on. Upon my enquiring (which I did at my first interview), how it was that the premium had been awarded to another, when my plan was considered the best, I was informed that the committee, anxious to do all in their power to insure justice to the several parties who had intrusted them with their designs, had submitted the several plans to two gentlemen in London, eminent in their profession, and that they had strongly recommended the adoption of my design, but considered I was not entitled to the premium, through not having, as *they thought*, acted in strict compliance with that portion of the advertisement which directed that the principal front should face Bute-street: and they concluded that this could not have been my intention, because the altar would not in that case have been at the east end of the church.

In this respect however my intentions were misunderstood, in consequence of my East Elevation having been described "Principal Front," instead of Front facing Bute-street, and in thus deviating from the usual custom of placing the Altar at the East-end, I considered I had sufficient precedent in the many Churches recently erected in which the Altar is not so placed.

Had this explanation taken place before the premiums had been awarded, Messrs. W. and B. would have been spared the unpleasant correspondence they have had with the Committee on the subject, as I should in that case have received the premium, as well as the appointment of Architect to the Church.

Your insertion of this in your next Journal will oblige, Sir,

Your obedient Servant,

THOMAS FOSTER.

4, *Park-street, Bristol, Feb.* 17, 1840.

*** This communication ought to have appeared in the last month's Journal, but it was accidentally omitted.—EDITOR.

REVIEWS.

On the Use of the Improved Papier Mâché in Furniture, in the Interior Decoration of Buildings, and in Works of Art. By Charles Frederick Bielefield.

This is not, as our readers might think, an exclusive catalogue of Mr. Bielefield's well known productions, but a large work containing engravings of above 500 approved ornaments used by architects, so as not only to be available for its special purpose, but useful to all members of the profession. As a work of reference or ornament this possesses the advantage that any design the architect may select, can be obtained at the shortest notice, while of these given in other works it generally happens that they cannot be obtained except at great cost for making models, &c. The architect can from these engravings select and combine a great variety of valuable specimens in every class of ornament.

Prefixed to the engravings is a history of the manufacture, to which we shall have occasion to refer in our next number.

Geometrical Propositions Demonstrated, or a Supplement to Euclid, being a Key to the Exercises appended to Euclid's Elements. By W. D. COOLEY, A.B. London: Whittaker and Co., Ave Maria Lane, 1840.

The present is scarcely a supplement to the able edition of Euclid by Mr. Cooley, but a distinct work, intended to impress on the public the true value of geometry—its excellence as a method of reasoning and training the mind. The author well observes, that merely to read Euclid is not to become a mathematician, nor to attain all the advantages to be derived from geometrical studies, that we must not stop short, but carry out the methods of reasoning of which examples are afforded to us by that valuable work.

Guide to Ornamental Drawing and Design. By J. PAGE. London Berger, 1840, Parts 1 and 2.

This work is one of the best and cheapest which has been written on the subject, and from the pen and pencil of a practical man, who has had the advantage of being able to see his instructions carried into effect under his own inspection, as Director of the Class of Ornamental Drawing, in the School of Design, at Saville House. If it were any recommendation to the work it might be mentioned that the illustrations proceed from the graver as well as from the pencil of Mr. Page.

The Year Book of Facts in Science and Art. By the Editor of the Arcana of Science. London: Tilt, 1840.

We are too large contributors from our own columns to this valuable record of the progress of science to view its improvement and success with any other feeling than that of congratulation. We sincerely recommend this work to our readers as one of the best condensations of valuable facts in science and art.

Claverton Inn.

This is an engraving of a building, built by George Vivian, Esq. on his property near Bath. It is in the Italian Villa style, and though not quite pure is a most interesting edifice. The outline is worked sufficiently without being frettered up, and has a most picturesque effect in harmony with the surrounding scenery. It is a good study.

Specimens of Wood Engravings. by THOMAS GILKS.

Pleasing examples of this interesting art, and creditable to the talents of the engraver.

LITERARY INTELLIGENCE.

A new publication by Schinkel, entitled Werke der Baukhunst, is about to appear in parts, at intervals of four months from each other, and will be more elaborately executed than his Entwürfe, as some of the plates will be printed in colours. Among the subjects promised are the designs for king Otho's palace, on the Acropolis at Athens, which though not adopted,—the building now erecting being from one by Gärtnor, of Munich, may be expected to prove of no ordinary interest, some parts of the interior having been spoken of as exceedingly striking, both for their originality and for their extraordinary richness, in regard to gilding and colouring. This subject will be illustrated by twelve plates, some of which will probably contain two or three drawings. Another subject mentioned in the prospectus is prince Albert of Prussia's palace, or villa of Camenz in Silesia. The size of the plates will be 26 inches by 15. Another German work announced for publication is Ehrenburgh's Bau Lexicon, or Dictionary of Architectural terms, &c., of which we shall be able to speak more at length in a short time.

SIR JEFFRY WYATVILLE, R.A.

THE subjoined memoir we have derived from Fisher's National Portrait Gallery, the Literary World, Art Union, Athenæum, &c.

SIR JEFFRY WYATVILLE, Knight of the Saxon Ernestine Order, R.A., F.R.S., and F.S.A., was the son of Joseph Wyatt, an architect, resident at Burton-upon Trent, in the county of Stafford, where he was born on the 3rd of August, 1766. His father was considered clever, but indolent, and, therefore, afforded but a poor example for a boy of enthusiastic and enterprising spirit, such as young Jeffry soon proved himself to possess. He received the common rudiments of education at the free-school of his native place; and his early passion was for the sea. During this time, he was once "rigged out" for a voyage with Admiral Kempenfeldt, on board the *Royal George*, but was fortunately prevented from joining that noble ship, which was afterwards lost at Spithead. Home, however, became not only irksome, but painful, to him, from the improvidence of his father; and, in 1783, he made a third and succesful attempt to fly from both, and seek his fortune in the metropolis; but could not obtain any engagement in the naval service, as the American war had then ceased.

Upon young Jeffry's arrival in London, he found a friend and protector in Samuel Wyatt, his father's brother, then an architect and builder of repute; with whom Jeffry continued more than seven years, and thus acquired considerable knowledge of the ordinary office business, and of practical construction. Mr. S. Wyatt was extensively employed, both in London and at the seats of many noblemen and gentlemen in the country, namely, at Eaton Hall, Tatton Hall, the Trinity House, London, &c., all of which were executed from his designs; and, consequently, afforded his nephew opportunities of witnessing all the processes of designing, estimating, and executing, buildings of various kinds. In the hope of acquiring further professional knowledge, and particularly with a view of cultivating that essential requisite in art, taste, young Wyatt sought these advantages in the offices of another uncle, Mr. James Wyatt, who had attained a higher station on the ladder of fame than his brother. He had passed some years of architectural study in Italy, and, while yet a minor, he designed and built "the Pantheon," in Oxford-street, and was introduced to the appointment of Surveyor-General of his Majesty's works, his first labours being various alterations and additions at Windsor Castle, at the suggestion of King George III. In the office of Mr. James Wyatt, his nephew served a second term of apprenticeship; and, besides improvement in practice, thus obtained numerous introductions to influential persons, among whom was the Prince of Wales, who honoured him with personal notice up to 1799. In this year, Mr. Jeffry Wyatt joined in business an eminent builder, who had extensive government and other contracts. In this profitable concern he continued till 1824: when, after an absence of twenty-five years from Royal intercourse, he unexpectedly received from King George IV. instructions respecting designs for the restoration of Windsor Castle.

The union of the tradesman with the architect was deemed, by the Royal Academicians, a sufficient bar to the advancement of Mr. Jeffry Wyatt to be one of their society; and he was allowed to continue as a candidate for twenty years, before he was admitted a member. During this period, he made many designs for public and private buildings, which were erected in different parts of the kingdom, some of which manifested architectural talents of a high order. He was, at length, elected an associate, and speedily afterwards, one of the Royal Academicians. Among various designs which he had exhibited at that nursery of the arts, was one called "Priam's Palace," which attracted much admiration during the exhibition. This, and his other architectural drawings, and executed buildings, are ample evidences of his love of, and devotion to, his profession.

One of the first acts of the new Parliament, after the accession of George IV., was the projection of great alterations and improvements in the magnificent castle-palace at Windsor. For this purpose, it was agreed that the three attached architects to the Board of Works, Messrs. Soane, Nash, and Smirke, with Mr. Jeffry Wyatt, should be directed to make plans, drawings, and estimates. The sum of £300,000 had been voted by Parliament towards the expenses of these improvements, and a commission of eight noblemen and gentlemen, members of the administration and of the opposition, were appointed to advise as to the works and expenditure of the money. Among these "Commissioners" were the Earl of Aberdeen, President of the Society of Antiquaries, and Sir Charles Long, (subsequently Lord Farnborough,) a distinguished Fellow of that enlightened institution: both men of refined taste in the higher departments of art. In May, 1824, the respective architects above named (with the exception of Mr. Soane,) submitted their drawings to the Commissioners, when the designs of Mr. Jeffry Wyatt were approved of, and accepted. The Commissioners next visited Windsor; the plan of operations was settled, and, on the 12th of August, 1824, the birthday of George IV., the first stone was laid by the King, it being part of the foundation of the new gateway on the southern side of the Great Quadrangle, and thenceforth named George the Fourth's Gateway. On this occasion, the architect received the royal authority for changing his name to Wyattville; not merely as a personal compliment, but for the purpose of distinguishing and separating the Wyatt of that reign from his uncle, Mr. James Wyatt, whose share in the architectural works at Windsor, during the reign of George III., has already been mentioned. Furthermore, George IV. suggested and conferred the additional armorial quartering to the architect's family arms, of a view of George the Fourth's Gateway, with the word *Windsor*, as a motto.

Without the aid of plans and views of the buildings, it is impossible to convey to the reader any clear idea of Windsor Castle at the time that Mr. Wyatville commenced his improvements, in 1824, and at the period of their recent completion. It may be sufficient to mention, that the alterations and additions made in the Castle buildings, from the commencement of the Tudor dynasty to the year 1824, were not only inharmonious with the castellated character of the older works, but were generally tasteless in design, and slight and bad in execution. Hence the whole of the latter class were taken down, when the whole of the main timbers were found to be decayed. New floors and ceilings, with new partition walls, were necessary; and to improve the exterior effect of the elevations, each wall was raised several feet, and finished with bold embattled parapets. The angular and intermediate towers were also augmented in height, and each crowned with a machicolated summit. The chimney-shafts were formed into stone clusters, and made to assume the shapes of turrets. Around the south and east sides of the interior of the great quadrangle, was erected a spacious corridor, 550 feet in length, connected with and forming grand and convenient approaches to the chief suites of apartments which belong to those parts of the Castle.

The works proceeded with such rapidity, (the architect devoting the whole of his time to the vast undertaking,) that, on the 9th of December, 1828, the King's private apartments were completed, and his Majesty removed from his rural retreat, a superbly embellished cottage in the Great Park, and formally took possession of the Castle. The next public act of the King was to confer the honour of knighthood on his architect, who, also, was permitted to take up his residence in a commanding tower, in the middle ward, at the west end of the north terrace.

The progress of the repairs was rather expedited than stayed by the King having taken up his residence at the Castle. The decayed and dangerous state of the building had, however, occasioned an expenditure much beyond the original estimates; indeed, at Midsummer, 1830, the cost appeared to have been nearly doubled.

Application was, accordingly, made to Parliament for further advances; when, opposition being raised in the House of Commons, a committee was appointed to investigate the Castle works, and the probable amount of money requisite for their completion. The committee, at length, ordered works to be undertaken to the estimated amount of £148,796, to be advanced at the rate of £50,000 per annum. This grant was made exclusively for the architect's department, independent of the upholsterer, decorator, and other artisans. Since that time, much has been done. The Elizabethan Gallery has been finished, and fitted up as a library; the Waterloo Gallery has been completed, and adorned with portraits, by Lawrence, of the principal monarchs, statesmen, and generals of Europe; the old principal staircase has been removed, so as to present an uninterrupted view from the northern terrace, *through the superb pile* by means of opposite entrances, to the unrivalled Long Walk on the south; a noble staircase having been elsewhere constructed, in which is placed a colossal statue of George IV., nine feet, six inches high, by Chantrey. Lodges have also been erected at the junction of the Long Walk with the Home Park; and several of the old state apartments, at the north-west part of the upper court, have been enlarged and substantially repaired. At the north-west angle of this court, Sir Jeffry had designed a splendid chapel. The heightening of the Keep, or Round Tower, by some feet, is also an improvement which adds pre-eminently to the dignity of the magnificent pile.

It has been well observed, "so completely has Sir Jeffry made the Castle his own, that nobody else can distinguish between what belongs to himself and his predecessors." The style of the building is old, while the material is new; and the harmony of parts is so complete as to form a whole of almost inexpressible massiveness and grandeur.

Von Raumer, on his visit in 1833, found Windsor far exceeding his expectations, and making a greater impression on him than all the other castles he had ever seen, put together. "This is high praise," says the Literary World, "from a native of Germany, where feudalism has left so many stately monuments of its frowning glory.

Hitherto, there has been published no fitting record of this grand national repair of the proudest structure that England possesses. King George IV., with the intention of consummating the truly regal labour, and, in strict princely state, commanded Sir Jeffry Wyatville to publish an account of his great work: the missive, in the handwriting of the sovereign, is in the possession of Sir Jeffry's executors, as is also a confirmation of the command, from Queen Victoria. Sir Jeffry had made much progress in his task; he having expended £3000 upon drawings.* In the Picturesque Annual, the author relates, that George IV. promised to send a copy of Sir Jeffry's work to every sovereign in Europe; but, with the exception of this patronage, Sir Jeffry, it is believed, although working at the Royal command, did not expect assistance of any kind. On one occasion, when surprise was expressed at such a condition, Sir Jeffry replied, in the spirit and pride of art; "The task is MINE; I am preparing my own monument."

Notwithstanding that Windsor Castle is the *chef d'œuvre* of Sir Jeffry Wyatville, and, for ages to come, will stand as the best record of his skilful taste, he had wholly built, or improved, many other edifices in different parts of the kingdom. He has left some of his works in thirty-five, out of the forty, English counties, and four, out of the twelve, Welsh. From a list of above 100 of these buildings, the following, with the names of their owners, are appended to the memoir already quoted:—

Badminton House, Gloucestershire, Duke of Beaufort.—Drawing-room and library.

Woburn Abbey, Bedfordshire, Duke of Bedford.—Temple of the Graces.

At Endsleigh, Devonshire, Duke of Bedford.—A spacious and commodious seat, in the cottage style.

Chatsworth House, Derbyshire, Duke of Devonshire. Some magnificent new buildings, also alterations and restorations of the old mansion, in the Italian style. These have just been completed.

Longleat House, Wiltshire, Marquis of Bath.—New conservatory, stables, offices, staircase, and alterations of the hall, &c.

Ashridge, Hertfordshire, Earl of Bridgewater.—The completion of the house, begun by James Wyatt, R.A.; the Bridgewater column in the park, and lodges.

Bretbey, Derbyshire, Earl of Chesterfield.—Parts of the house.

Gopsall, Staffordshire, Earl Howe.—A new lodge, &c.

Belton House, Lincolnshire, Earl Brownlow.—New green-house, and alterations to the mansion.

Wollaton Hall, Nottinghamshire, the Lord Middleton.—Alterations to the interior, and new lodges to that fine Italian house.

Sidney College, Cambridge.—New gate-house, and fronts to the whole college.

Besides the above, which are generally called show places, Sir Jeffry has designed and executed the following *new houses*:

Lilleshall, Shropshire, Earl Gower.
Golden Grove, Caermarthenshire, Earl of Cawdor.
Nonsuch Park, Surrey, Samuel Farmer, Esq.
Dinton, Wiltshire, William Windham, Esq.
Denford, Berkshire, William Hallett, Esq.
Stubton, Lincolnshire, Sir Robert Heron, Bart.
Hillfield Lodge, Herefordshire, The Honourable G. Villiers.
Trebursye, Cornwall, The Honourable William Elliot.
Banner Cross, Yorkshire, General Murray.
Wimborn, Dorsetshire, William Castleman, Esq.
Claverton, Somersetshire, John Vivian, Esq.
Hastings, Sussex, Compt de Vandes, &c. &c.

By the introduction of Queen Adelaide, Sir Jeffry designed a castle for Altenstein, for her brother the reigning Duke of Saxe Meiningen; as also a palace, with extensive stables, and a riding house for Meiningen; for which works the Duke presented him the grand cross of the Saxon Ernestine order, as a mark of his approbation. In the summer of last year he designed the stables at Windsor Castle. This design, though of almost quaker like plainness, evinces the same strong faculty for arrangement under difficult circumstances, which characterized all his former works. As late as November last, he designed lodges for the Sheffield and Derby entrances to Chatsworth: the latter of which is full of boldness and originality, and as vigorous as any design he ever produced, although his last work, except an Alcove for the gardens, which is as playful as the work of a young hand.

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* Mr. Weale has received instructions to publish this splendid work forthwith.

Sir Jeffry Wyatville was proud of the Royal patronage which he enjoyed; and the Sovereign was alike proud of his favorite architect. As a compliment, a portrait of him was painted by Sir Thomas Lawrence, by command of George IV., and was placed in the royal collection at Windsor Castle. It is considered to be, altogether, an impressive likeness: there is extraordinary quickness in the eye, and the forehead is lofty, but wants breadth, such as indicates superior intellect. We believe Sir Jeffry to have been in no degree indebted for his success to sycophancy; for, although "of the court" he was not over courteous in manner. His roughness, however, enabled him to conquer the caprice of his royal patron. It is related in the *Athenæum*, that "when the Kings private apartments were under consideration, his Majesty was naturally somewhat more peremptory than usual, especially as to their relative proportions, and it is well known that he did not like large rooms. Wyatt's head, however, was full of a palace; and when the king suggested what he considered a proper size for his dressing room, Wyatt protested that such a cupboard was better suited to a country curate than to his Majesty. The latter, however, was peremptory on the subject, and cut short all remonstrance with—" It shall be so." The works went on—the suite of apartments was finished and furnished, when, in the exultation of the moment, his Majesty good-humouredly reminded the architect of their former difference, and triumphantly referred to the admirable adaptation of this particular chamber. 'I am glad your Majesty approves of it,' said the architect, 'for it is exactly twice the size your Majesty directed."

He languished for the last five years, under a disease of the chest, which has visited him with voilent attacks from time to time; and frequently endangered his life. Still his mind never gave way, or was weakened by illness. He possessed the same good sense, industry, and indefatigable order in his art during his last illness, as at any former period of his career—which was marked by simplicity and integrity, as was his death by perfect cheerfulness and resignation. His last days were a dignified lesson to the old, as his well spent life had been a model of usefulness to the young. He died on the 18th of February, in his 74th year.

The remains of Sir Jeffry Wyatville were interred in St. George's Chapel, Windsor, on the 25th ult.; the body having arrived at the Winchester or Wyatville Tower, on the preceding evening. The Rev. Dr, Goodall, Provost of Eton, an old and valued friend of the deceased, read the burial service; and the coffin was deposited in a vault in the east aisle of the Chapel, just behind the altar; which Sir Jeffry had prepared some years since, for the reception of the remains of his daughter, who, it is stated, died in consequence of a cold, taken during her attendance at the ceremony of laying the foundation stone of theBrunswick Tower. Among the mourners was Sir Francis Chantrey, the sculptor. And thus, within the shadow of the stately pile which his genius had restored from crumbling decay, sleeps the architect himself; thus exemplifying the adage: "Art is long, and life is but short."

NOTES OF THE MONTH.

The Oxford Society for the Study of Gothic Architecture is making progress, its library is increasing, and the papers read at its meetings have been valuable and interesting. It is to the clergy that we must look for the preservation of old edifices, and for the observance of good taste in the erection of new ones.

Mr. Cockerell has been selected to erect the new Institute at Oxford, founded by the late Michael Angelo Taylor.

The second of this month is the day on which the tenders are to be sent in for construction of the Nelson Memorial. The shaft is to be solid, of granite from the West of England, and the capital of bronze.

Messrs. Grissell and Peto have commenced operations for raising the superstructure of the New Houses of Parliament.

The Royal Exchange affair is still in statu quo, except that as far as report goes Mr. Cockerell and Mr. Tite are engaged in making fresh plans. We doubt much whether they will be able to produce a better design than that of Mr. Donaldson, which we had another opportunity of viewing, when it was exhibited at the Royal Institute of British Architects. If, as Mr. Smith reported, at maximum prices it only exceeded the sum allotted by £9000, it ought to be adopted. As to the paltry objection that there were no chimneys, any man with brains in his head might have seen that they could have been introduced in any part of the walls which surround the room, the thickness of which was ample for flues, but the system of warming public offices by hot water or steam is so general that it could hardly be thought necessary to provide fire-places. Then again as to the statement that many walls had false bearings, even if such had been the case, this might easily have been remedied without in any way interfering with the external design, which is the grand feature to be considered. As to the last objection, that there were not sufficient shops, it is too contemptible to require notice.

Another competition exhibition takes place this month, that on the 8th for laying out the grounds of the Royal Botanic Society. We hear that many designs of merit are in preparation, and we sincerely trust that the Council will allow a public day for the profession to witness an exhibition, which we believe has never before taken place in the metropolis.

On the first (anomalous day!) the Soane Museum opens to the public! When will this Museum and Library of Architecture be made what it ought to be?

The Institute of Architects of Ireland has received the Royal patronage, and we sincerely trust that the institution will be worthy of a capital possessing so many fine buildings.

A new shop in the style of the Revival is now attracting attention in Regent-street, being the first in this fashionable style.

Some Elizabethan pumps a little above the common run have been erected in Holborn and its vicinity.

The wood pavement in the Strand is on Parkin's plan.

Iron statues are in great vogue at Paris as accessories for architectural purposes.

The embankment of the Thames is at last likely to be taken up by governvernment and city authorities.

We feel great pleasure in announcing that a want severely felt by artists, that of a gallery of casts is at last to be remedied, not by government, but by private enterprise. A similar plan was stopped last year in expectation of the government doing something, but it was so absurd that it was fortunate it was abandoned, being neither more nor less than to interfere with private enterprise, by manufacturing all kinds of casts. A worthy companion to the steam boat plan! Mr. Braham, with great public spirit, has opened the Model Gallery at the Colosseum as a place for study at the trifling subscription of one guinea per annum. It is well lighted, and contains above a hundred works, including the Tragic Muse (12 feet high), Apollo, Townley Venus, head of Achilles, Moses of Michael Angelo, &c.

There is an intention on the part of government to make a grant to the Schools of Design. This would be a boon to the manufacturing interests and the fine arts generally.

A statue to Napier, the inventor of logarithms is in agitation at Edinburgh.

At the Institute of Civil Engineers Mr. Nasmyth exhibited his pneumatic mirror, which is a plate of glass 3 feet in diameter, on a concave disc of iron hermetically sealed. On exhausting the air the plate collapses, and on its being forced in the plate rises so as produce any form of speculum. Mr. Nasmyth suggests its application to astronomical purposes for large reflecting telescopes, or it may be used as a burning glass.

Mr. Whishaw the engineer kindly exhibited to us a valuable chronometer which he has used in preparing for his elaborate work on Railway Statistics, for ascertaining the velocities of railway trains. It is 3 inches in diameter, and consequently of a circumference of near 9½ inches, which is a scale of one minute decimally divided into hundredths, so as to enable nice calculations to be made with accuracy.

In the valuable paper of Mr. Leeds in our present number, we took the trouble to note down the length of life of 142 architects enumerated, and found one-third between 65 and 75, of which 27 between 70 and 74, and 22 between 75 and 80. A pretty good proof of the longevity of this class of professional men.

We have not had the opportunity of mentioning before the completion of the lighthouse on the sands at Fleetwood on Wyre. This is constructed by Mr. Mitchell with his patent mooring screws, on a similar principle to that on the Maplin sands described in the Journal. It is of an hexagonal form, six mooring screws supporting the base with one in the centre thus,

o o
o o o
o o

These carry converging posts on which the platform is erected, which carries the lighthouse, so that it is open below to the action of the sea. This work, in an incomplete state, stood out the late severe gales, and does great credit to its constructor, and to the spirit of Sir Hesketh Fleetwood.

A BILINGUAL STONE.

A bilingual inscription, containing Latin, Umbrian, or Etruscan words sculptured on both sides of a Tiburtine stone, was found some months ago near the ancient ruins called Mausoleo. At first it was believed to be apocraphal; but on being brought to Rome and examined, all doubts with regard to its authenticity were removed. From the Latin words *Frater eivs minimus*, which occur in the beginning, it was hoped that something of interest might be deduced. The rest of the inscription can only give room for conjecture, the letters running from left to right, as is evident from the expressions, *Locavit et statuit*, which in themselves contribute in no way to elucidate the obscurity of the Epigraph, and it is well known that the national paliography whether Umbrian or Etruscan should run from right to left. This stone was in all probability a terminal *Cippius*, referring to the period when the Romans made Etrusia a subjected province, as yet, however, the true and precise signification is obscure, first on account of its bilinguous form, and also for the uncertainty of the letter X: which is known to be a T in Umbrian or Etruscan. Another ambiguity arises from not knowing the true pronunciation of K and ▷◁. This however must be left to the consideration of the learned, and for whose better judgment we subjoin the following copy of the epigraph.

The best preserved side.	The most defaced.
....	....
S	....
DRVTEI. F. FRATER	...... V. EIVICIVIV
EIVS	......NISIS. DRVTI. F
MINIMVS. LOCAVIT	...... RATER. EIVS
ET. STAVIT.	..MINIMVS. LOCAVIT. E.
EX. EICNFXI. XIↄVX	.........ATVIT QVI.
IICNI. ICFIↄNIXV	....ERNFXI. XOVXI. I.
FOXVF▷◁KCNSIS. X	.... NIXV. LOKFN. KO
DVXIKNCIS.	..........XIKNOS.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF CIVIL ENGINEERS.

SESSION, 1840.

Jan. 14. JOSHUA FIELD, V.P., in the Chair.

"*Observations on the efficiency or gross power of Steam exerted on the piston in relation to the reported duty of Steam Engines in Cornwall, at different periods.* By JOHN SCOTT ENYS, Assoc. Inst. C. E.

The advantages which may result from the union of scientific and practical knowledge in the application of steam power, particularly with reference to the limits of gross power, are great, as likely to check the extravagant notions entertained by some with respect to the farther increase of duty, and to remove the disbelief of others with respect to the amount of duty actually performed.

The limit of duty for atmospheric steam may be readily arrived at, as was done by Mr. Davies Gilbert in 1827, by estimating the weight of water which would rise 34 feet into a vacuum formed by the condensation of steam of atmospheric strength; whence it appears, that a higher duty than 30 millions cannot be obtained by atmospheric steam, 14 cubic feet of water being evaporated by a bushel of coal. Tredgold, in the first edition of his Treatise on the Steam Engine, published in 1827, adopted the simpler method of multiplying the volume of steam of atmospheric strength by the pressure, for the measure of the efficiency. This principle may be extended to measure the efficiency of steam at higher pressures, as the author has shown in the first annual report of the Cornwall Polytechnic Society; and an extended table to ten atmospheres is appended to this communication.

The author then proceeds to show, that the Cornish engines are worked under conditions such that a large proportion of the expansive action of the steam is available on the piston, and calls attention to two necessary corrections—1st, for the deficiency of water in high steam cut off at $\frac{1}{5}$th of the stroke; and 2d, for the increase of temperature of the steam during expansion in the cylinder, as derived from the steam jacket. The experiments of Mr. Wicksteed, confirmatory as they are of the very extended experiments made by Woolf at Wheal Alford, show the importance of this latter correction. Some error has also arisen from the use of the boiler pressure. The exact determination of the pressure in the cylinder is difficult, and the only recorded experiments are those by Mr. Henwood with the common indicator, and published in the second volume of the Transactions of the Institution. The indicator is liable to show a pressure higher than that actually exerted during the expansion, but it may be relied on for comparative results; and very accurate experiments made at the Consols by a mercury gauge, the engine being stopped at differents parts of the stroke, are said to confirm the reliance which may be placed on the indicator.

The quantity of water evaporated was very imperfectly recorded; it was stated by Watt as from 8 to 12 cubic feet per bushel, and at present may be stated at about 14 cubic feet, but is sometimes, with good coal and careful stoking, much higher.

The author briefly alludes to the progress of improvement in Cornwall; the introduction by Woolf of high steam; the substitution of the plunger pole for the bucket pump, and the application, so recently made by Mr. James Sims, to stamping or crank engines of the arrangements which had been a long time so advantageously in use in pumping engines.

The communication is accompanied by a table, exhibiting the weight of water per cubic foot; the pressure; the volume and the efficiency of steam from one to ten atmospheres, adapted and corrected from those of Clement and Desormes. It is also accompanied by a method of representing several particulars connected with the load and engine; by which the relation of these with respect to each other in the same engine, and the different conditions of other engines, may be at once exhibited to the eye. It may also prove a convenient method of recording facts and calculations in connexion with the Indicator Diagrams.

"*Analysis of a piece of the iron heel post converted by the action of Sea Water into a substance resembling Plumbago.*" By DAVID MUSHET, A. Inst. C. E.

A piece of the iron heel post of a vessel called the John Bull had been presented last Session by Mr. Borthwick, as a curious specimen of the effect of salt water in converting iron into a substance resembling plumbago. This substance was of a dark brown colour, and easily cut by a knife, and Mr. Mushet undertook to analyse it; and the result of this analysis, and the methods pursued, are the subject of this communication. This substance, which it may be convenient to call marine plumbago, on being exposed to a red heat in a crucible, lost about 20 per cent. in weight, and on being exposed to a white heat for four hours lost about 60 per cent., and came out a light mass of very brilliant carburet. This shining carburet was then used as a carbonaceous substance for the reduction of an oxyde of iron, but was less efficacious than the same quantity of the charcoal of wood. From these and other experiments, Mr. Mushet considers 100 parts of the so-called marine plumbago to be composed near as follows:—

Carbonic acid and moisture .	20
Protoxyde of iron . . .	35·7
Silt, or earthy matter . .	7·2
Carbon	41·1

Also, he considers 100 parts of the common black lead to consist as follows:

Carbonic acid and water .	12·5
Iron	11·5
Earthy matter . . .	4·5
Carbon	71·3

"*A theoretical calculation of the Fuel saved by working Steam expansively.*" By J. W. LUBBOCK, Hon. M. Inst. C. E. &c. &c.

An equation may be readily formed for the action till the steam is cut off; and the steam being then supposed to dilate into a certain volume, the variation in this volume gives rise to the quantity of action, whence another equation may be obtained, and the maximum of the quantity of action produced by cutting off the steam determined. The quantity of action thus produced is then compared with that produced in any case without cutting off the steam. Now the quantity of heat or fuel expended is proportional to the steam generated in each of the preceding cases, and a proportion, expressing the ratio of the fuel saved to the fuel expended, may be obtained.

"*On the Expansion of Arches.*" By GEORGE RENNIE, F.R.S.

The expansion of solids, which has excited the attention of mathematicians since the investigation of La Hire, in 1688, on a rod of iron, is of particular importance in the construction of bridges, the security of which may be effected by the dilatation and contraction consequent on changes of temperature. Periodical motions, referable only to changes of temperature, were observed by Vicat in a stone bridge built over the Dordogne at Souillac, and have frequently been noticed in structures of all kinds. The different expansibility of stone and iron has been considered an objection to the use of cast iron pillars in connexion with stone to support the fronts of buildings; but the experiments of Mr. Adie of Edinburgh led him to the conclusion, that no danger is to be apprehended from a change of temperature affecting cast iron and sandstone in any great degree, as their expansion, so far as regards buildings, may be considered the same.

Arguments from this source were employed against the arches of Southwark Bridge, and the experiments set forth in this communication were undertaken with a view of ascertaining the effect of temperature on these arches.

Three sets of experiments were made: the first in Jan. 1818, when the main ribs and diagonal braces rested on their centres, and before any of the spandrils and road plates had been put upon them; the second, in the August and September of the same year. The rise was measured by the insertion of small wedges to about $\frac{1}{40}$th of an inch. The third set of experiments was made on the eastern arch. Three thermometers were employed—one hanging in the open air, another having the bulb immersed $1\frac{1}{2}$ inch in the iron, and the third hanging amongst the ribs; these were observed at different hours of the day, and the results recorded. The rise of the arch was observed by a fine piece of feathered edged brass, nicely fixed to the rib, which by the rise and fall of the arch traversed upon a scale graduated to $\frac{1}{80}$th of an inch. The tables contain experiments on nine days, with the temperatures and rise at every hour of the day. The results, that is, the maximum temperatures and rise, and rise for 1° Fahr. are exhibited in the following table.

No. of Experiment.	Variation in Temperature.	Rise in Arch.	Rise for 1° F.
I.	15°	$\frac{25}{80}$	$\frac{1}{48}$
II.	10°	$\frac{16}{80}$	$\frac{1}{50}$
III.	7·5	$\frac{13}{80}$	$\frac{1}{47}$
IV.	11°	[illegible]	$\frac{1}{40}$
V,	6°	$\frac{13}{80}$	$\frac{1}{37}$
VI.	4·5	$\frac{10}{80}$	$\frac{1}{36}$
VII.	3°	$\frac{9}{80}$	$\frac{1}{26}$
VIII.	8°	$\frac{14}{80}$	$\frac{1}{45}$
IX.	7·5	$\frac{21}{80}$	$\frac{1}{28}$

The mean rise is $\frac{1}{40}$th of an inch for 1° Fahr.

Mr. Rennie then proceeds to calculate the theoretical rise from the expansion of iron, according to Lavoisier, in an arch of the dimensions of Southwark Bridge, for 50° increase of temperature.

The effects of changes of temperature were also observed in the stone bridge over the Thames at Staines. After the arches had attained their full settlement, openings were observed in the joints of the parapets immediately over the springing of the arches, and a distortion or sinking of the upper curve of the parapets. A wedge was inserted into some of these openings, and the lowest point of its descent in the month of January marked. The same wedges were carefully inserted every week until May, when they would no longer enter, and the joints became firmly closed. At this period, however, the joints immediately over the crowns of the arches, which had during the winter been quite close, were now open. From these facts it followed, as a necessary consequence, that in winter the arch contracting descended and the spandril joints opened, and in summer the arch expanding rose and closed these joints, and opened those at the crowns. Thus the joints of the parapets, which were made of single slabs of granite for the whole height, became good indicators of the changes of temperature. It had also been observed, in the Waterloo and other bridges, that joints made good in the winter with Roman cement were found crushed in summer.

With the view of obtaining some data for calculation, Mr. Rennie procured samples of granite, sandstone, and slate, and placing them in a properly constructed oven, ascertained the rates of their expansion, which are given in the paper.

A series of experiments was made at the request of the late Mr. Rennie by Mr. S. Walker, of Rotherham, on the variations in the length of 231½ feet of the frieze, bolted together and laid on a firm platform. The temperature of the atmosphere and of the plates and the length were noted at five o'clock in the morning and at three o'clock in the afternoon, and in some of the experiments at seven o'clock in the evening. The details of these experiments are given in the paper.

The paper is accompanied by calculations for the rise of an arch and the opening at the spandrils for an increased temperature, and also by tables of the expansibility of different kinds of stones and irons given by Distigny.

"*Specification and Working Drawings of the Middlesborough-on-Tees Gas Works.*" By Peter Henderson, Assoc. Inst. C. E.

In this communication, the author details the several works, erections, and fittings of the Gas Works at Middlesborough-on-Tees, and the mode in which they are to be executed and completed.

"*On a mode of Dowelling Timber, or of combining it and other materials for general purposes.*" By M. J. Brunel, M. Inst. C. E.

The author proposes to unite timber by means of iron dowels and asphalte. Mastic had been used in the Tunnel works for the purpose of fitting small plates of cast iron to the poling boards. These, though constantly immersed in water and mud, and subject to severe hammering, had stood perfectly well. Asphalte is now used in preference to mastic, as it sets immediately. The author conceives that stone may be united by a similar kind of dowelling; and that wood may be interposed between stone and iron, so as to be used to advantage with the stone blocks, for the chairs of railways. Also, that this method may be used with great advantage in ship-building, in mast-making, and wherever any species of dowelling is required.

Feb. 21. The President in the Chair.

"*On Steam Engines, principally with reference to their consumption of Steam and Fuel.*" By Josiah Parkes, M. Inst. C. E.

The above is the second and concluding communication on this subject; in the former, the generation of steam more particularly was considered; in the present, its application when generated. These are distinct questions, as it is the economy of steam which constitutes the dynamic perfection of a steam engine, whereas it is the economy of heat in supplying that steam which constitutes the perfection of the boiler as an evaporative vessel. These economic properties are totally independent of each other; they may co-exist in a maximum degree, or in very different degrees, and the degree of perfection which any particular class of engines, or which the particular engines of any class possess, is known from the weight of fuel burnt, of water evaporated, and the mechanical effect realized. As long as engines were constructed with but few varieties, or identical in their forms, the performance of one was a sufficient indication of the performance of all; but new forms of engines and new modes of practice being now introduced, a comparison of the performance on the several systems is a matter of deep practical and scientific interest. With the view of effecting this object, the author has collected all the authentic facts within his reach, and reduced them to common standards of comparison.

The effective power of steam engines may be ascertained either from the resistance overcome, or from the load upon the piston by means of the indicator; the former method being applicable to pumping, the latter to rotative engines. But the effective power of the steam in pumping engines, as thus ascertained, is far below the real effective power of the steam, and no exact comparison can be made by these means between the effective power of the steam in the two classes of engines. The useful effect is not synonymous with a true measure of effective power, since the duty is the true useful effect in a Cornish engine. The indicator when applied to the Cornish engines enables us to ascertain the absolute but not the effective power, so as to compare it with that of the rotative engine, since the friction of the engine and the load cannot be separately determined. The absolute power of the steam may also be ascertained from the relative knowledge of the elastic force of steam corresponding with the ratio which the volumes of water bear to each other. This theoretical estimate requires however several corrections; among which the steam condensed by contact with colder surfaces, the steam consumed in filling useless places, and that lost by priming, must be particularly noted.

The relative performance of pumping engines is well expressed by the term "duty," that is, the number of lbs. raised one foot by a given quantity of fuel; and of rotative engines by the term "horse power," that is, the number of lbs. raised one foot in a minute, divided by 33,000 lbs. the standard measure of a horse. The performance of the rotative engine may also be estimated by duty, and of pumping engines by horse power. The results of these computations for several engines are tabulated in this communication.

The sum of the latent and sensible heat being constant for steam of all elasticities, the expenditure of both power and heat is truly measured by the weight of water consumed as steam; this measure is free from all uncertainty, and independent of all theory; the weight of water as steam equivalent to the production of a horse power in each engine, and the duty effected by one pound of steam, will denote the positive and relative efficiency of the steam and the heat. These indices of efficiency being referred to some standard, we learn, from the preceding data, the precise value of each engine in its use of steam and fuel; of its boiling apparatus, as a generator of steam; of the comparative efficiency of the steam and coal, or economy of power and fuel. The results which may thus be obtained are also exhibited in tables, accompanying the communication.

The power resulting from the expenditure of equal weights of water, as steam, being known, the boiler may be connected with the engines, and the relative extent of heating surface employed to furnish their power shown. It will thus appear that equal measures of surface are quite inadequate to supply equal power, with equal economy, to different classes of engines. These results are tabulated in great detail, and it appears that the Cornish engineers now employ nearly eight times as much boiler surface for equal nominal power as that given by Watt's practice. But taking into account the fuel burnt per horse power per hour in the two cases—the Cornish engine consuming 2½ lbs. per horse power per hour, and Watt's engine 8½—the true relation of the boilers is as 19 to 1. Many other relations of a similar striking character may be deduced from these tables.

The detailed results of the experiments by Smeaton in 1772, on his improved Newcomen engine at Long Benton—by Watt, in 1786, on his rotative condensing engine, at the Albion Mills, are recorded in these tables; and it appears that the economy of the latter as regards steam and fuel was double that of the former, and approached very nearly to perfection in the use of power obtainable on that principle. The next great advance in the economy of fuel and power is that made by the Cornish engineers, whose performances, both with pumping and rotative expansive engines, far exceed any attained with the common unexpansive condensing engine. The superiority of two of these engines in 1835, doing a duty of 80 millions, exceeds the engines of Watt and Newcomen by 2½ and 5 times in economy of power, and by 3½ and 7 times in economy of fuel.

The obtaining a standard measure of duty is of great importance; a heaped measure, as a bushel of coals, is highly objectionable, as the weight of such measure will vary from 84 to 112 lbs. In the Cornish reports the bushel is fixed at 94 lbs. weight, as the standard of comparison, but some portion of a ton or one lb. would be a better standard. Other combustibles, however, as coke, peat, &c., may be used partially, or to the exclusion of coal, and under these circumstances some other standard of comparison is necessary, and with this view the author suggests a pound of water in the form of steam as the best standard of duty. The work done by a given quantity of water as steam is a sure index of the quality of the steam engine; it is a measure uneffected by variable calorific agents, and so long as engines continue to be worked by steam, so long will the performance of different engines be accurately gauged by their respective expenditure of water as steam. The accuracy of this measure depends on the physical fact of the constancy of the latent and sensible heat in steam of all temperatures. The author has recorded twenty-eight experiments made on twenty-eight different days, on vaporization from the boiling point to 60 lbs. pressure above the atmosphere, which present a remarkable confirmation of the above law, and show that the relative efficiency of steam in engines is due to the manner of using it, and not to any change in its chemical constitution at different pressures. The manner of conducting these experiments, and the precautions taken to ensure accurate results, are detailed with great minuteness.

The author next proceeds to treat of the Locomotive Engine, and to discuss, compare and tabulate the facts relating to this engine in the same manner as he has done those of the stationary class. The qualities of the boiler of the locomotive as an evaporative vessel had been discussed in the first communication. The locomotive differs from the fixed non-condensing engine only in the use of the blast, and the same method of measuring the effects of the steam are applicable to both. Experimenters on the locomotive have generally attempted to determine the amount of resistance opposed to its progress in preference to ascertaining the power expended in overcoming the resistance. The exact solution of either of these questions would furnish all that is wanted; but the ascertaining the total resistance by an analysis of its several constituents is attended with great difficulties, as the forces to which they are to be referred are so exceedingly numerous and variable, that the assigning the exact value to each at any one velocity has hitherto eluded the talents of those who have pursued this method. M. de Pambour was the first analyst whose labours will require attention. The results given by this author in his practical treatise on Locomotive Engines on Railways were compared by Mr. Parkes with the results which he had obtained when experimenting on an engine of precisely a similar character, and discrepancies presented themselves which appeared totally irreconcilable. These and other circumstances led the author to consider, whether the resistance to traction would properly be deduced from the laws of gravitation, or whether any certain results would be derived as to the amount of resistance on a level from observations on engines and trains moving down inclined planes. The great object seemed to be to discover some criterion of the mechanical effect produced by a locomotive at all velocities, which would apply as practically and as distinctly to a locomotive as duty to a pumping engine, or horse power to a rotatory engine. If this were possible, it seems of far less importance to distinguish the precise value of each particular unit of resistance, than to determine the relative sum of resistance and the relative expenditure of power at all velocities and under all circumstances. Now the term duty may be applied in the strictest sense of the term to the work done by a locomotive engine; for whether the engine drag a load whose resistance is 8 lbs. per ton, or whether a weight of 8 lbs. for each ton of matter moved descending over a pulley and attached to the load, be considered as the moving force, the result is the same. If, then, the tractive force, or resistance per ton of matter in motion, which is the real load on the engine, be ascertained, the whole effect is found by multiplying this sum by the space passed over in feet; and the consumption of water as steam and of coke being known, we have all the elements requisite for determining the duty performed by the steam or coke. The pressure against the pistons may be deduced from the sum of the resistances first calculated on the assumed resistance overcome at the velocity of the engine in each experiment; and the pressure on the pistons may also be deduced from the ratio of the volumes of the steam and water consumed. The results which may be obtained on these principles are tabulated, for the experiments of M. de Pambour, Robert Stephenson, and Dr. Lardner. In another table the author has recorded the reduction of each of these experiments to terms of horses' power, and has exhibited under that denomination the absolute power resulting from the steam used—that required to overcome the assigned resistance—their differences—and the power which balances the gross and useful duty. The construction of these most elaborate tables is described in great detail, and the consequences which follow from the tests thus obtained are fully stated, and the author comes to the conclusion, that results inconsistent with the capabilities of the locomotive are perceptible in almost every one of the experiments. A condensing engine placed on wheels, with water of condensation transported for its supply, and made to drag a train along a railway, would require the same expenditure of water as steam, to produce a given effect, as if fixed; a non-condensing engine also is one and the same machine, whether fixed or locomotive, excepting that the latter must consume more power than the former, to do equal work, at like pressures, by the amount of the additional resistance arising from the contraction of its eduction pipes, in order to produce a fierce blast of steam through the chimney. From these and other causes the fixed non-condensing engine must be the more economical of the two; but if the results derived from M. de Pambour's data be correct, we must acknowledge the fixed non-condensing engine, with its simple atmospheric resistance, to be far inferior in economy of steam to the locomotive, with its plus atmospheric resistance. The experiments by Dr. Lardner were made for the purpose of determining the resistance opposed to progressive motion on railways. They consisted in dismissing trains at various speeds from the summit of inclined planes, and in observing their velocity when it became uniform, the resistance at such velocity being equal to the accelerating force of gravity down the inclined plane. The results of these are tabulated in the same manner as the preceding, and the most singular discrepancies present themselves. For instance, it would appear that in one particular case a duty of double the amount of that effected by the condensing engine was performed by an equal expenditure of power; that compared with a fixed non-condensing engine at equal pressure, the locomotive, though labouring against the heavy counter-pressure of the blast from which the other is free, is assumed to have performed equal work with less than one-half the expenditure of power. That if the resistance assigned by Dr. Lardner as opposed to the progressive motion of the train be correct, the efficiency of the steam in the locomotive is more than double that obtained by the best condensing engines; more than treble that derived from stationary non-condensing engines, and equal to the performance of a Cornish expansive engine, doing a 50 million duty with a bushel of coals. With such results before us, the resistances assigned as opposed to and overcome by the locomotive at different velocities, must be regarded as utterly inconsistent with reality, and as resting on no solid foundation.

The preceding results show also that errors have crept in by the adoption of the theoretical method of reducing undulatory surfaces to a level. M. de Pambour extends the length of the road as a compensation for the acclivities or for the help afforded by the bank engines, and Dr. Lardner diminishes the time of the trip to that which he assumes would be occupied in performing it on a dead level. If the principles on which these corrections for the acclivities and declivities are made be correct, other facts than we are at present acquainted with must be taken into account before it can be demonstrated that a given power will convey a given load at some certain increased velocity along a level compared with the actual velocity along any given undulating line. The resistances which enter into the composition of the sum of the forces are ever varying to such an extent, that it may be doubted whether the theoretical level be not a pure fiction with reference to the practical results of the experiment.

The effective power of a locomotive engine, or the excess of power after overcoming its proper friction and the resistance from the blast, is solely expended in the generation of momentum. This which is the product of the mass and the velocity represents the useful mechanical effort exerted by the steam, and may always be ascertained under all the practical circumstances of railway traffic. The consumption of power as water in the shape of steam, is a third quantity which may also be readily ascertained. The application which may be made of the above data is comprehended in the following propositions. First, that equal momenta would result at all velocities from an equal amount of power expended in equal times by the same engine, if the forces opposed to progressive motion and to the effective use of steam in the engines were uniform at all velocities. Secondly, the difference between the momenta generated by a unit of power in a given time at various velocities, measures the difference in the sum of the resistances opposed to the power at those velocities. Having ascertained the gross weight of an engine tender and train—their mean velocity—and the expenditure of water as steam during the trip, simple computations will inform us of

1. The mechanical effect realized by a given power at all velocities.
2. The total increase or decrease of resistance at all velocities.
3. The ratios which the increase or decrease of resistance at different velocities bear to the ratios of those velocities.

Two other results also follow from the above, and which may be termed the commercial results, viz. the amount of gross and useful tractive effect realized by an equal expenditure of power at all velocities. The difference between these is a useless quantity in a practical sense, being the costly waste of power incident to the locomotive functions of the engine and tender over and above the waste arising from the unascertained and ineffective portion of the whole power required for the blast. The reductions and computations necessary for the exhibition and development of these views are contained in two tables. They relate to forty-nine experiments, being those already referred to, and those by Mr. N. Wood, on the Great Western, and London and Birmingham Railway, and some others. One of these tables contains the velocity of the engines, the consumption of water as steam, the loads, the absolute momenta per second; the momenta generated by equal power in equal times, viz. by 1 lb. of water as steam per second; the weights of the gross and useful loads moved by equal powers, viz. by one cubic foot of water as steam, at the velocity of each experiment, with various other elements. The other table contains a summary of the ratios of the velocities and of their squares, brought into juxta-position with the ratios of the power expended to produce equal momenta, equal gross and equal useful effects, by the comparison of pairs of experiments on the engines given in the preceding table. This table also shows the influence of velocity in the expenditure of power to produce equal mechanical and equal commercial effects; and the amount of loss attributable to the increase of resistance at the higher velocities. The author discusses in great detail the various circumstances of these experiments, and the inferences and practical conclusions which may be deduced therefrom: and comes to the conclusion, that the determination of the performance of locomotive engines by the methods here set forth is as practicable, exact, and demonstrative of their relative powers and dynamic excellence, as the determination of duty done by pumping engines.

The intensity of the pressure on the opposite side of the piston arising from the blast has been but imperfectly stated. By some the discharge of the steam has been likened to a jet, and considered continuous. But an attentive observer can appreciate by his ear that an interval exists between the alternate discharges of steam from the two cylinders. That these jets are periodic and not continuous, is also distinctly evidenced by the audible pulsations in the chimney, even at the very highest velocities of an engine, and their duration may be measured at lower speeds. Upon this intermittent action of the blast depend, in a great measure, the resultant pressure against the piston, and the production of a sufficient current of air through the fire, both which effects would be materially changed in intensity by the substitution of a continuous for a periodic current. The precise duration of the jet or of the time of the steam evacuating the cylinder, can only be determined by direct and careful experiments; but its period may be ascertained within definite limits; for since a single discharge is completed within the time occupied by the piston in accomplishing a half stroke, and the pauses between two successive discharges are distinctly perceptible, a single blast cannot occupy the fourth part of the time of the revolution of the crank shaft, and very probably does not exceed the eighth part, or the period of a quarter stroke of the piston. Under no circumstances, then, can the pressure from the blast oppose the piston much longer than during one fourth of the stroke. With an active pressure, then, of 30 lbs. per square inch, the mean resistance from the blast would not be greater than 7½ lbs., and with a pressure of 15 lbs. not greater than 3¾ lbs. per square inch, against the pistons. The author then proceeds to cite several observations and experiments made by himself, which are confirmatory of the preceding argument respecting the blast, and he was led conclusively to the fact, that one fifth of the power of the engine experimented upon, at working pressures of 20 lbs. and 15 lbs., was absorbed in blowing the fire; and that the escape of the steam from the cylinder was four times swifter than the motion of the piston.

The author lastly treats of the expenditure of power for a given effect by fixed and locomotive non-condensing engines. But few experiments on the expenditure of steam for a given effect by non-condensing stationary engines have been made. The relative consumption of fixed condensing and non-condensing engines has been treated of by the late Mr. Charles Sylvester, of Derby, whose knowledge and accurate theoretical analysis of the subject are shown by the close accordance of his conclusions with the facts established on two engines of these classes at certain working pressures. His conclusion that the relative economy of these engines will be as the quantities of steam consumed, or as 1 to 1·72, at those pressures, is accurately confimed by the results here recorded. Mr. Sylvester also showed, that by increasing the pressure upon the same non-condensing, and by enlarging the area of the condensing engine's cylinder and air pump, so as to maintain the steam in it at a uniform pressure per square inch for all loads, the economy of the former would gradually approach and finally equal that of the latter. The results obtained in the preceding part of the paper, furnish numerous comparisons between the locomotive and fixed non-condensing engines, and the consumption of the latter has been used, together with the condensing engine, as the test of the accuracy of the data of resistance assigned to the former by the various analysis. The accurate determination of the expenditure of steam by the same locomotive engine, in which the values of the friction and of the blast pressure were ascertained, admits of the consumption of water as steam for given effects being determined, and thus narrows the grounds of doubt, and establishes more correct data for ascertaining the real resistance opposed to progressive motion on railways. The application of these principles, as borne out by the experiments of the author, and their particular bearing on the experiments which have been the subject of the previous ample and detailed discussion, form the conclusion of Mr. Parkes series of communications on steam boilers and steam engines.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

3rd Feb. 1840, W. R. Hamilton, Esq., Hon. Fellow in the Chair.

J. H. Good, jun., was elected an Associate.

A paper was read by Ambrose Poynter, Esq., Hon. Sec. entitled, "*some remarks on arabesque decorations, particularly those of the Vatican.*" An abstract of this paper appeared in the last months' Journal.

It is requisite that we should notice an error which occurred in the report of Mr. Poynter's paper on arabesque ornaments, in our last number. Some extracts had been selected from it, which owing to the unavoidable absence of the Editor, were inserted without the necessary connexion being supplied, and were, moreover, unfortunately misplaced in printing. We think this explanation due to Mr. Poynter—we hope that we shall be able, at some future opportunity, to print this very interesting paper in full, illustrated by engravings.

17th Feb., John Shaw, Esq., Fellow in the Chair.

Mr. C. H. Smith read a paper "*on the properties of various stones used for building.*

At a Special General Meeting, 21st Feb., H. E. Kendall, Fellow in the Chair.

It was Resolved—That the President Earl De Grey be respectfully requested to present to her Majesty the following address on the part of the Institute.

ADDRESS.

The President, Vice Presidents and Members of the Institute of British Architects, deeply impressed with the honour conferred upon them by your Majesty's most gracious patronage, beg leave humbly to offer their sincere congratulations on the occasion of your Majesty's auspicious marriage.

That every blessing of this life may attend your Majesty and your illustrious Consort throughout a long and prosperous reign is the earnest prayer of your Majesty's most loyal and dutiful subjects.

2d March 1840, H. E. Kendall Fellow in the chair. The following gentlemen were elected Fellows:—Charles Parish, George Alexander, and David Brandon from the class of Associates;—Associate, Evan Christian.

T. L. Donaldson, Esq. Fellow, read a paper "*on the recent discoveries made at the Porta Maggiore, Rome,*" communicated by Signor Canina, Hon. and Cor. Member.

Mr. C. H. Smith read the conclusion of his paper "*on the properties of stone used for the purposes of building.*

Monday, March 16, George Moore, Fellow, in the Chair.

The following gentlemen were elected: as Fellow, Edward J'Anson, jun.; as Associates, William Hinton Campbell, of Bath, and George Pownall.

Anthony Salvin, Fellow, presented ten guineas for the purchase of books.

T. L. Donaldson, Esq., read a paper on a system of framing for floors and roofs of large span, and applicable to bridges, whether of timber or iron, communicated by Herr Laves, architect of Hanover, Hon. and Cor. Member.

Question respecting the origin of the vertical line in architecture, and the return to the horizontal line in Italian buildings. By Sir Gardner Wilkinson, Hon. Fellow.

In offering the following observations to the consideration of the Institute, it is not my object to suggest, but to elicit an opinion upon the subject; feeling as I do that it would be presumption for me to do more than state the facts which have led to my remarks, when I had an opportunity of submitting it to those who are so capable of giving it a satisfactory explanation.

It is universally admitted that the principal features which distinguish Greek from what may be called Church Architecture, are the horizontal line in the former, and the vertical in the latter; and some have supposed that to church architecture is to be ascribed the origin of the vertical line. That it is common to buildings of the Saracens, the Lombards, the Saxons, and the Normans, as well as to those of the pointed style, is sufficiently obvious: thus far our experience tells us we have traced it, but beyond this, conjecture has not attributed to it an existence, nor has its origin been ascribed to any more remote source.

In the oldest Saracenic Mosques, erected about the middle of the 7th century, the style of architecture is evidently borrowed from Roman buildings. Their arches are simply imitative of the Roman style; the windows though small have a round arched head; the corridors are formed of avenues of single slender columns supporting round arches, and the type of the Roman original is readily traced; as in the earliest churches of Europe, which also present the round arch of the Roman style. But in both these we find the lines already vertical; and that this might be expected from what we see in the monuments of ancient Rome, is the point to which I wish particularly to advert.

Those buildings erected by the Romans in imitation of the Greek, as temples, and some other monuments of a borrowed style, present the horizontal line of that architecture to which they really belonged, and of which they were copies; and since we find this to be the case in all countries of modern Europe where Greek architecture is imitated (even though it is notorious that the vertical line is the prevailing feature of our taste) we cannot be surprised that the same should have been done by the architects of Rome. But whenever the Romans attempted any thing of their own, in which they thought a deviation from Greek models was allowable, we no longer perceive the horizontal, but the vertical line predominating; and to such an extent, that even a Greek entablature is sacrificed to this their favourite sentiment, being broken up into detached parts and compelled to project and recede, in order to allow the vertical line to pass continuously through it to the summit of the building.

In an arch of triumph, a Roman composition, though the mouldings and many other details are borrowed from the Greek, the vertical line commences with the pedestal of the columns appended to its side, and extending upwards with the column, breaks through the entablature, which it obliges to come forward to carry out and mark its direction, requires a projection of the attic to correspond with the capital above the cornice, and terminates in a statue; thus continuing it uninterruptedly from the base of the summit of the building. This is not confined to an arch of triumph; the same occurs in other monuments; a remarkable instance of which may be cited in the remains of the Forum Palladium, or Forum of Nero, (according to the Chevalier Bunsen), where the whole entablature is made to advance from the face of the wall to the distance of SEVERAL feet, and is crowned by a similar projection of the attic, in order to correspond with the vertical line of the column which supports it; and the same taste for breaking up the horizontal line of Greek entablatures may be seen in numerous Roman buildings, the neplus ultra of which occurs in the monstrosities of Petra.

Thus then we find the vertical line did not originate with the architecture of Christian Europe; it occurs in the monuments of ancient Rome; and this interesting question naturally suggests itself,—whence did it proceed, was it of Italian origin?—In the Rome of a Christian era the same occurs throughout its churches; which is the more remarkable, as those churches are not of what has been termed Gothic, but of Greco-Roman or of Cinque-cento style; and in these the vertical line extends from the lowest to the highest part. Even domes and cupolas are not exempt from its intrusion; it commences with the basement of the column, and extending upwards through the projecting entablature and the attic, it continues in bands over the whole convex surface of the dome, requires a corresponding pilaster or half column in the lantern, and exhausts itself only in the extremity of the cross, or whatever point terminates the building: a good example of which may be seen in the cupola of St. Peter's, whose façade, a memento of Bernini, not only unites the most glaring defects in taste, but affords an illustration of the worst application of the vertical line. After viewing these monuments, and observing the feeling which pervades them, every one must be surprised at the sight of the splendid palazzi of Rome, and other cities of Italy. In these we no longer perceive the vertical, but the horizontal line predominating, which is carried out with wonderful effect, both in the rich and splendid cornices that crown the building, and in the string courses beneath the windows. In these no broken entablature injures the harmony of the straight line, no sinecure columns are suspended at the side of the walls to do nothing but spoil the effect of the whole mass, and we perceive that their architects did not put together a number of details to form a whole, but conceived the whole, and made the details accessory to the general effect. So evident indeed is this, that the details are sometimes bad, and still the whole is excellent; as in many pictures of the great masters, where the composition and execution of the painting are of far greater importance, and far more striking to an artist than the imperfection of an accessory; like the sandal in the picture of Apelles.

Whence came it that Italy adopted this horizontal style, in which she has given such magnificent and graceful monuments? They are her own; and no Greek models were the origin of these noble conceptions. This is another interesting question; and it is with a view to obtain some explanation respecting *the origin of the vertical style in ancient Rome, and the return to the horizontal style in the palaces of modern Italy*, that I have offered the foregoing remarks to the Society; fully persuaded that many here present have been struck with the same curious facts, and are enabled to offer an explanation of them, which my inexperience on such a subject forbids me to suggest.

SELECT COMMITTEE ON RAILWAYS.

[SECOND REPORT TO THE HOUSE OF COMMONS.]

The select committee appointed to inquire into the state of communication by railways, and who were empowered to report their observations, together with the minutes of evidence taken before them from time to time, to the House; have further considered the matters to them referred, and have to report, that they have taken into their consideration the following clause which has been referred to them by the House:—

"And be it enacted, that no bridge or tunnel, or approaches to the same, for carrying a turnpike-road over or under any part of a railway or canal, shall be made or constructed of less width between the fences, walls, or parapets thereof than 21 feet; nor shall any bridge or tunnel, or approaches to the same, for carrying any other public carriage-road over or under any part of a railway or canal be made or constructed of less width between the fences, walls, or parapets thereof than 16 feet; nor in any case less than so much greater width, not exceeding 30 feet, as may be the average width of the turnpike or other public carriage-road for 100 yards on each side of that part of the railway or canal where any bridge or tunnel is intended to be made or constructed."

Your Committee have upon this subject examined Mr. Palk, the legal adviser of the Chairman of Committees in the House of Lords, and it appears from his evidence, that about the end of the year 1836, complaints were made to the Chairman of the Committees, and he introduced clauses into all subsequent railway bills, containing the provisions here annexed, and which your Committee will now proceed to compare with the clause referred for their consideration.

The rule which since that period has, with few exceptions, been adopted by the Chairman of Committees in the House of Lords, provides that the width of turnpike roads passing under bridges or tunnels should be 25 feet, and the width of highways passing under bridges or tunnels should be 15 feet.

The clause referred to your Committee for their consideration provides, that no bridge or tunnel for carrying a turnpike-road under any part of a railroad or canal shall be constructed of less width than 21 feet, and no bridge or tunnel for carrying any public carriage-road under any part of a railway or canal, shall be constructed of less width than 16 feet.

It will be perceived, therefore, that as regards a turnpike-road, the clause referred to your Committee requires a less width by four feet than has been required by the rule adopted in the House of Lords, while, as regards a highway or public carriage-road, an additional width of one foot is required more than has been deemed necessary by the regulations of the House of Lords. These regulations further provide, that the height of a bridge or tunnel passing under a railway should be 16 feet. This appears to your Committee to be also an important regulation. It will be found in the evidence annexed to the second report of the Committee on Railways in the last session, that it has been especially provided that the bridges or tunnels for carrying turnpike-roads under the Brighton Railway shall be 18 feet in height, and it is stated that this height was insisted upon for the convenience of the farmers and hop growers in that district. The rule of the House of Lords also requires that the width of a turnpike-road upon a bridge passing over a railway must be 25 feet, and the width of a public carriage-way 15 feet, with a parapet-wall in each case four feet high. A reference to the analytical table in the appendix to the second report of the Railway Committee of last session, will show that these regulations have been introduced into all the Railway Acts since the year 1836.

Your Committee would now recommend to the House that in all original Railway Acts, and in all Railway Acts authorizing new works in the present session of Parliament, the rule of the House of Lords should be adopted as to works to be carried into execution under the provisions of those Acts respectively, with this addition, that in every bridge or tunnel the arches should spring from abutments of not less height than 10 feet. Your Committee would also recommend that in all Railway Acts authorizing further works, passed in any future session of Parliament, the rule shall be as follows, with respect to works to be carried into execution under the provision of those Acts respectively:

Whenever a turnpike-road passes under a railway, the width of the bridge or tunnel shall in no case be less than 30 feet, and there shall be on each side footways of 2½ feet in width. Whenever a public carriage-road passes under a railway, the width of the bridge or tunnel shall be not less than 20 feet, and there shall be on each side footways of 18 inches wide; the height of the bridge or tunnel shall in no case be less than 16 feet, and the arches shall spring from abutments of not less than 10 feet in height.

Similar provisions might also, with advantage, be made applicable to all canal bills which shall in future be introduced into Parliament.

Statistics of Gas.—For lighting London and its suburbs with gas, there are 18 public gas works; 12 public gas work companies; 2,800,000*l.* capital employed in works, pipes, tanks, gas-holders, apparatus; 450,000*l.* yearly revenue derived; 180,000 tons of coal used in the year for making gas; 1,460,000,000 cubic feet of gas made in the year; 134,300 private burners supplied to about 400,000 consumers; 30,400 public or street consumers.—About 2650 of these are in the city of London.—380 lamplighters employed; 176 gas-holders, several of them double ones, capable of storing 5,500,000 cubic feet; 890 tons of coals used in the retorts on the shortest day, in 24 hours; 7,120,000 cubic feet of gas used in the longest night, say 24th December; about 2500 persons are employed in the metropolis alone in this branch of manufacture; between 1822 and 1827 the quantity nearly doubled itself, and that in five years; between 1827 and 1837 it doubled itself again.

Portsmouth Floating Bridge.—This bridge, which will shortly be opened, is seventy feet in length, and sixty in breadth, and is capable of holding on each side, besides passengers, two rows of carriages seventy feet long; she is impelled by two engines of twenty-horse power each, the cylinders being eighteen inches in diameter, and the length of the stroke three feet. The average rate of the engines will be about thirty strokes per minute, and the average speed about 350 feet per minute; so that she will perform the passage (2200 feet) in about seven minutes. She only draws, with all her machinery on board, two feet and nine inches, and fifty tons additional weight will only sink her four inches.

STEAM NAVIGATION.

The *Nemesis* iron steam ship, 165 feet long, 29 feet beam, 660 tons, built by John Laird, of the Birkenhead Iron Works, Liverpool, with engines of 120 horse power, made by George Forrester and Co. Liverpool. On her passage from Liverpool for Odessa, she struck on a sunken rock when going 9 knots per hour the damage she sustained was trifling, requiring only about 2½ cwt. of new iron, and 12 men about 6 days to repair it; not a rivet was started—the injury was confined to the part actually *dinged or cut;* the repairs might have been completed in three days at Liverpool, where every convenience could have been had. It is stated by some parties, well acquainted with the circumstances, that had the vessel been timber built, she would not have been got off at all; but all agree that had she got off the repairs would have been both tedious and very expensive. The leak caused by the blow was so trifling that the *Nemesis* might have steamed for months without being obliged to dock. The accident occurred about the 10th ult., she steamed 300 miles afterwards, was discharged, docked, repaired, reloaded and ready for sea again by the 26th ult., with all her stores and coals on board.

PROGRESS OF RAILWAYS.

CROYDON RAILWAY.

Mr. Cubitt's Report to the Directors on the Cost of constructing the Railway.

[We have given this report in full, as it contains a great deal of valuable information to the profession.]

Gentlemen, *London, March* 9, 1840.

"The object of this report is to set forth the cost of constructing the Croydon Railway.

"In performing this duty it will be necessary to refer back to a period previous to the general meeting in August last, at which time the affairs of the Company were undergoing an examination by a committee of proprietors, by whom I was called upon, to aid and assist them in their labours.

"As much dissatisfaction at that time existed with regard to the great cost of the works, and the little information which existed on the subject, it occurred to me that nothing could tend to satisfy the minds of the proprietary so much as a clear statement of the cost of all the various parts of the work, and in a short report of the Committee of the 7th of August, I stated the way and manner, and the number of heads in which I recommended the accounts to be called for, and which were as follow:—

I. Acts of Parliament, including all legal and professional charges of all kinds incurred in soliciting and passing the various bills; the whole drawn out in a detailed form.
II. Land, buildings, and compensations of all kinds for the line of railway, and stations, together with all legal charges attending the same, and the expenses of all kinds attendant on obtaining possession of the land, &c., in detail.
III. Earthwork, bridges, fencing, draining, and forming the line of railway, as per contracts and otherwise, and also all extras upon contracts, setting forth in a clear and detailed form the whole cost of formation, bridging, fencing, draining, &c., up to the line of ballasting.
IV. Ballasting, sleepering, and laying the permanent way complete, including all turn-plates, sidings, and expenses of all kinds attending the trackways of the line.
V. Water apparatus, including engines, pumps, standards, pipes, and erections of all kinds relative to supplying the locomotive engines with water.
VI. Stations, showing the amount of contracts, and an account in detail of all extras thereon.
VII. Engine and carriage houses, workshops, implements, machinery and apparatus of every kind, for repairing and maintaining the locomotive engines, &c.
VIII. Wharfs, railway cranes, and works connected with the Grand Surrey Canal Junction.
IX. Sundries of various kinds not reducible to the above heads.
X. Engineering and supervisal of all kinds.

"Such were the accounts which I recommended the Committee to obtain, and which statement was remitted to the engineer as instructions to furnish to me, in detail, the accounts as therein specified.

"This requisition, which involved much labour and of necessity would occupy a great length of time, was most readily and cheerfully responded to by Mr. Gibbs, who not only caused the whole of the engineering accounts and expenditure to be arranged in detail under their respective heads, from III to IX. inclusive, but induced Messrs. Grissel and Peto, the contractors for the stations and buildings, to do the same with all their work, and who, much to their credit and at a very heavy expense, furnished in detail a minute account of all the work executed by them for the Company.

"To the heads, Nos. I, II, and X., I have not received any returns, but as they form no portion of the construction of the railway, and the first two not being in the engineer's department, and the last relating to private and personal accounts of the Company, may be considered as sufficient reasons for not being included in this inquiry.

"As it will be difficult, if not impossible, in a report of this kind, (which is intended to afford as much general information as possible in the shortest compass, and in a way to be understood by the general body of the proprietors) to enter very minutely into the accounts, I shall therefore submit to the board a general abstract or statement of the whole work, under the separate heads contained in my instructions, dividing each head into the principal items of costs of which it is composed, and refer for further particulars to the books themselves, premising that every entry in the book, or statement furnished to me, is referred to original day-book, journal, or ledger, in which the accounts have been entered and kept; and I have the assurance of the parties by whom the accounts have been analyzed, that out of the whole amount there are not 500*l.* for which vouchers are not producible, and which, in so large an amount, of which I had heard it surmised that no regular accounts had been kept, I think it very unsatisfactory.

"Of course, it is not in my province to go through and compare every entry in a voluminous and mixed set of accounts; a return has been made to me, as nearly as possible in the spirit and letter of my instructions, and that not in the form of a mere abstract but in great detail, and with every entry referred to the book from which it was extracted; which books, also, as before observed, were sent to me for inspection, and are now in my possession; and if it would be any satisfaction to the board or the proprietary, I shall have no objection to attend the general meeting therewith, and to afford any information and explanation in my power on the subject; but the following abstract of the accounts will show in what way the capital of the Company has been disposed of, as far as works, buildings, and machinery, are concerned.

"Such is the statement of cost which I have been enabled to make out and submit to the meeting, and which I have no reason to think is otherwise than correct, depending of course on the correctness of the data from which it was formed, but which I have no cause to doubt; the books, however, are before the meeting, and will be found, I think, to bear both external and internal evidence of being original documents, with entries made at the time; and in my judgment not the less valuable in this case for not being the most perfect system of bookkeeping that could be devised.

"As regards the correctness of the charges and the amount of works done over and above the contracts, there is no means of proving it in every instance, especially in day-work and sundries, which form a large amount. An approximate check might certainly be obtained as to the success of cuttings in flattening slopes, and getting out slips in the large contracts, by going into a remeasurement of those portions of the work, but this would involve a considerable expense, and it is doubtful whether the result would justify the expense to be incurred; still I am ready to go into it if the Board think it proper to do so. In connection with this part of the subject, it is due to the engineer to state, that I have been furnished with the cross sections and dimensions of all the extra cuttings from which the accounts were deduced; and in conclusion, I may be again allowed to observe, that on the part of Mr. Gibbs, your principal engineer, and Mr. Dean, the assistant engineer, there has been no lack of information, and that my acknowledgments are due to those gentlemen for the promptitude and readiness with which my inquiries have at all times been met.

"On the whole, then, after a careful and laborious investigation of the subject, I have no hesitation now in recording as my deliberate opinion, that which I had the honour to express verbally to a meeting of this Company some time before the railway was open to the public, and whilst the conduct of the Board at that time and the state of the expenditure were under the investigation of a Committee, viz.—that as far as the works are concerned (excepting any errors of admeasurement), there is value received, although probably at a high price, on account of circumstances in materials and labour for the money; and that the railway is well and durably laid; and that whatever want of judgment there may have existed in making out the original estimates, and lack of knowledge as to the extent to which the works would ultimately be carried, there has, in my opinion, been no want of honesty either in the management or the executive, as regards the execution of the works.

I have the honour to be, &c.,
"W. Cubitt."

TABLE OF COSTS.

	£	s.	d.
Head No. III. of Instructions—Formation of Line.			
1st—Earthwork.			
Forest Hill	26,703	13	9
New Cross Hill	30,131	2	4
Sydenham	11,718	2	3
Croydon	4,527	5	9
Total of Earthwork	73,080	4	1
2nd—Fencing, Draining, and preparing for Ballast, &c.			
Forming the way	426	0	4
Fencing, soiling slopes, &c.	4,649	11	6
Fencing and planting	6,763	3	7
Surface draining	2,817	19	6
Gates	486	9	2
Slips and extra slopes	11,138	11	11
Total forming Slips, &c.	26,281	15	0
3rd—Bridges and Culverts.			
Viaduct at Corbet's Lane	9,374	13	8
Boundary Walls at ditto	559	6	3
Timber Viaduct	2,505	15	0
Black Ditch Bridge	5,062	6	10
Surrey Canal Bridge	7,361	11	1
Cold Blow Farm ditto	618	12	2
Footbridge, Five Bell Lane	456	14	6
New Cross Bridge	3,161	7	0
Finches' Bridge	2,603	9	5
Deptford Common Bridge, No. 1	628	8	6
Ditto ditto No. 2	1,102	3	0
Calgate's Bridge	1,353	12	10
Owen's Bridge	1,032	12	11
Colson's Bridge	873	18	8
Sydenham Bridge	2,981	7	6
Anerley Bridge	1,761	13	6
Jolly Sailor Bridge	2,612	5	1
Croydon Common Bridge, No. 1.	1,069	3	10
Ditto ditto No. 2.	1,136	0	11
Cross Road Bridge	1,394	2	0
Total of Bridges	47,649	4	8
4th—Culverts.			
Deptford Common Culvert	451	5	4
Ditto ditto	412	9	3
Forest Wood ditto	129	0	9
At New Cross	1,418	18	11
,, Sydenham	1,786	19	1
,, Selhurst	115	17	9
Total of Culverts	4,315	1	1
5th—Retaining and Boundary Walls.			
Turner's and Sterry's	666	1	8
At Sydenham Bridge	3,451	7	3
Sydenham Station Walls	374	0	7
Jolly Sailor ditto	611	12	3
Dartmouth Arms ditto	1,513	14	8
Sundry Walls	141	0	2
Total of Retaining and Boundary Walls	6,757	16	7
6th—Diversion of Roads, &c. &c.			
At Cross Roads Bridge	448	11	7
Brockley Road	15	15	6
Dartmouth Arms ditto	543	1	0
New Cross	533	3	11
Viaduct Road	73	4	9
Sydenham Bridge	33	19	0
Jolly Sailor	101	3	0
Penge and Anerley Roads	350	0	0
Approaches to Nos. 1 & 2 Bridges	770	13	4
Surrey Canal Bridge Road	13	16	9
Sundry other Roads	1,936	15	0
Total making and altering Roads, &c. &c.	4820	3	10
Total of construction to Formation level.	162,904	6	3
Head No. IV. of Instructions, viz.—Ballasting, Draining, Timbering, and laying Permanent Way.			
1st—Ballasting the Line, exclusive of London Bridge Station	17,373	15	0
2nd—Drainage of Permanent Way	2,788	1	10
	20,161	16	10
3rd—Timbering the Line.			
Sleepers, timber, and preparing do.	24,890	8	10
Carriage of timber	1,943	9	2
Kyanizing ditto	4,793	3	8
Laying sleepers	5,113	8	2
Tarring ditto	223	17	11
Felt for rails	663	5	10
Total of timbering the line	37,627	13	7
4th—Rails and Laying.			
Rails, screws, and bolts	24,785	10	8
Labour and laying rails	968	17	0
Carriage, and removal by hand of ditto	1,847	19	5
Turnplates	2,151	1	10
Total of laying rails	29,753	8	11
	87,542	19	4
Head No. V. of Instructions.—Water Supplying Apparatus.			
At London Bridge Station	923	10	1
New Cross ditto	3,190	2	11
Croydon ditto	1,555	2	2
Total of water apparatus	5,668	15	2
Head No. VI. of Instructions—Cost of Stations.			
At London Bridge	40,301	5	8
New Cross	21,919	18	5
Dartmouth Arms	1,344	10	8
Sydenham	134	3	4
Penge and Anerley	454	2	4
The Jolly Sailor	2,366	0	4
Croydon	12,215	19	9
Total of Stations	78,736	0	6
Head No. VII. of Instructions, included in No. VI.			
Head No. VIII. of Instructions—Wharfs at Surrey Canal Junction and Croydon.			
1st—Surrey Canal Wharf and Incline	5,022	5	10
2nd—Croydon Wharfs.			
Wharf walls	2,750	17	5
Crane	37	0	10
Warehouses	968	4	0
Stables	86	3	0
Total of Wharfs	3,842	5	3
	8,864	11	1
Head No. IX. of Instructions—Sundries of various kinds, including Locomotive Engines, Carriages, Waggons, Consolidation of Way, &c. &c.			
1st—Houses and Cottages.			
Police Cottages	691	19	10
Switch Box at Junction	38	7	7
Ditto ditto at New Cross	33	8	0
Cottage at Brockley	199	12	3
Ditto ditto Selhurst	12	0	6
Storehouse, Coldblow	64	16	0
	1,040	4	2
2nd—Lighting.			
Light House at Junction	369	10	5
Expenses for Lighting Road.			
New Cross Station	374	10	0
Croydon Station	232	6	0
London ditto	302	1	1
Engine lamps, &c.	223	8	4
Light House at Junction	89	4	7
Ditto	349	18	7
	1,940	19	0
3rd—Consolidation of Way	11,146	18	10
4th—Locomotive Engines, Carriages, and Waggons	28,086	3	6
5th—Miscellanea and Sundries of all and various kinds	18,054	17	5
	60,269	2	11
Total	£403,985	15	3

"From the annexed statement arises the following general abstract, under the different heads of my instructions, viz.—

	£	s.	d.
Construction and formation of the line of railway to the line of ballasting	162,904	6	3
Ballasting and laying the permanent way	87,542	19	4
Buildings and machinery for supplying water to engines	5,668	15	2
Stations, workshops, &c.	78,736	0	6
Wharfs at Surrey Canal and Croydon	8,864	11	1
Sundries of various kinds, including locomotive engines, coaches and waggons, consolidation of way, &c.	60,269	2	11
Total cost of construction and seting to work	£403,985	15	3

Exclusive of land, parliamentary and law expenses, and engineering.

MANCHESTER AND BIRMINGHAM RAILWAY REPORT.

Mr. Buck's Report to the Board of Directors, (March 3, 1840.)

Fairfield Street Contract.—This contract is finished, with the exception of the bridge over Fairfield-street. The ironwork of this bridge is now in course of erection. Half of the main ribs are fixed, and I expect that in seven weeks from this date, all the roadway plates will be fixed, and the bridge ready to receive the ballasting. In my report of last September, I stated that the founder had undertaken to have the ironwork erected by the end of December last: however, he has been unable to work up to his calculations in this respect, by reason of the extraordinary wetness of the weather, which prevented the workmen from continuously proceeding with the fitting of the castings; an operation which, (from the nature of the work,) was necessarily performed in the open air. But it is satisfactory to state, that although some additional time has consequently been requisite for this portion of the work, the opening of the line to Stockport will not be retarded thereby.

Chancery Lane contract is finished, and the contractor for laying the permanent way is now ballasting the arches.

Hyde Road Contract.—The brick arches are all turned and ballasted, in readiness for the permanent way. About one-third of the parapet remains to be built. The ironwork for the cast iron arch over the Hyde Road, is now in progress of erection; all the main ribs, and a portion of the spandrills are fixed. I expect that the roadway plates will be ready for the ballasting in four weeks from this time.

Heaton Norris Contract.—The excavation is very nearly finished: about 8,000 yards only remain to be moved, in addition to that which has been reserved for ballasting the permanent way; and this will go out as wanted for the purpose. An opening remains in the embankment at the crossing of the Stockport Road and its diversion, where two temporary bridges have been erected during the construction of the permanent one. The masonry for the latter is at the height for the reception of the iron arch, which is ready, and will require about eight weeks for fixing. This is the only bridge *under* the line which is not built. Of the bridges *over* the excavation, there are five of various sizes in different states of forwardness, three being nearly finished. These will all be easily completed during the time of fixing the ironwork of the Stockport Road bridge. Of the permanent way, 5,100 yards of single road have been, and 13,400 yards remain to be laid. Here more was calculated upon, but the contractor has been unable to procure sleepers so rapidly as he expected; however, in consequence of recent arrangements which he has made in reference to a more expeditious delivery, I have every confidence in his completing the whole within the period of his contract.

Stockport Viaduct Contract.—The north abutment and seven arches are finished; three other arches are in different states of forwardness, and the centre is fixing for the eleventh. The pier on the right margin of the river Mersey is erected to the height of the impost, which is partly set: the preceding ten arches comprehend all that portion of the work on the north or Lancashire side of the river. The foundation of the river pier on the left margin is just commenced. Five other piers on the south or Cheshire side are in progress, one being nearly finished, and the others in proportionate states of advance. The foundations of the three next in succession are excavated, and the south abutment is partially erected. I have great satisfaction in stating that all the foundations are upon rock.

Castle Street Contract extends from the south abutment of the Stockport Viaduct to the Mecca Brook, a distance of two miles six chains. The contractor has just commenced operations.

The designs are prepared for that portion of the line extending from the end of the last mentioned contract to Alderley, a distance of seven miles seven chains.

I have every confidence that my former statement will be realised, and that the line from Fairfield-street to Stockport may be opened in the month of May next.

Midland Counties Railway.—This line of railway will be opened from Nottingham and Derby to Leicester, in May next, and throughout to Rugby in June, in time to receive the traffic when the whole line of the North Midland is opened. This important railway is one of the few in England that will be made with the original subscribed capital. It will be in full operation without the creation of either half or quarter shares; and notwithstanding the pressure in the money-market, so great has been the confidence in this undertaking, that the directors have already been enabled to borrow nearly the whole sum authorised to be taken on loan by their Act. The cost of the line, including everything, will only be about 22,500*l.* per mile.—*Railway Times.*—This railway will untimately become one of the most important lines in the kingdom, particularly if an act should be obtained for the Nottingham, Lincoln and Hull railway, which is sure to be carried into execution sooner or later.

Gloucester and Birmingham Railway.—This company appear to be using their utmost exertions to hasten operations along that portion of the line promised, in their late report, to be opened in the spring. On Monday last the directors and engineers inspected the works at the Cheltenham station, with the state and condition of which they expressed themselves much pleased; and, proceeding on the railroad to Tewkesbury, examined in like manner the different works in that neighbourhood. The return from Tewkesbury was accomplished in sixteen minutes; we believe the distance has been gone over before in thirteen. The engines to be employed on this line, if that now at work is to be taken as "a sample for all the rest," promise to equal, if not excel, those of any of the other railroads in the kingdom.—*Cheltenham Looker-on.*

MISCELLANEA.

A buried Village.—We find, in the *Progres du Pas de Calais,* the following account of the accidental discovery of a subterraneous village in the commune of Hermies, near Bapaume, which we are inclined to receive with some hesitation, till we meet with a confirmation of the statement. It is therein said, that during the late heavy rains a great land-slip took place close to Hermies, into which some of the young men of the place had the hardihood to descend, by means of ladders tied together. What was their surprise, to find themselves, at a depth of thirty metres, in the midst of handsome streets, bordered on both sides by cells and chambers, which had evidently been once inhabited! The streets are of width sufficient to admit of a carriage passing; and the chambers, of various sizes, are also of various degrees of comfort and elegance. Some are flagged; and their number is said to amount to between twelve and fifteen hundred. Among the objects by which the explorers were more particularly struck, was an old stone tower, with a winding staircase. This they ascended, and, having beaten through the vaulted roof, discovered that it opened into the belfry of the church of Hermies.

Architecture.—The Rev. John Parker, M.A. lately delivered a course of Lectures on Gothic Architecture before the members of the Shropshire and North Wales Natural History and Antiquarian Society. The lectures were principally directed to an explanation of the scientific construction of gothic vaulting, with a dissertation on the superiority of the upright or pointed gothic arch over the circular arch of the Anglo-Norman and other schools of architecture. The pre-eminence of the gothic vault in the conveyance of sound, and of the upright or pointed arch in the great particulars of lightness and strength, were clearly shown and most happily described.—Sections of ribbed work from gothic vaulting in Valle Crucis Abbey, the Castle of Beaumaris, Tintern Abbey, the Old Chapel of St. Stephen (the late House of Commons), Shiffnal Church, the Priory of Kenilworth, the White Abbey (in this county), St. David's Cathedral, Lichfield Cathedral, and Stoneleigh Abbey, were produced, with a model in wirework that pourtrayed the several forms in which the ribbed work of gothic vaulting could be made available by the artist; while the superiority and beauty of the pointed arch were illustrated by drawings made by Mr. Parker on visits to Kilpec Church, near Hereford, and to the ruins of Valle Crucis Abbey, aided by the more simple but effective application of scientific acquirement to that practical illustration which the course of lectures required to be made during the progress of its delivery. —*Salopian Journal, Feb.* 5, 1840.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM 29TH FEBRUARY, TO 28TH, MARCH 1840.

JAMES BEAUMONT NEILSON, of Glasgow, Gentleman, for "*certain improved methods of coating iron under various circumstances, to prevent oxidation or corrosion, and for other purposes.*"—Sealed February 29; six months for enrolment.

ROWLAND MACDONALD STEPHENSON, of Upper Thames Street, Civil Engineer, for "*an improved method or methods of adjusting, shifting, and working theatrical scenery and apparatus.*"—February 29; six months.

RICHARD EDWARDS, of Fairfield Place, Bow, Dealer in Emery Cloth, for "*improvements in preparing and combining of materials used in lighting or kindling fires.*"—February 29: six months.

JOHN SYLVESTER, of Great Russell Street, Engineer, for "*improvements in the construction of doors and frames for closing the openings of fire places, ash pits, flues, chimneys, and certain retorts.*"—March 3; six months.

JOSEPH SHORE, of Birmingham, Merchant, for "*improvements in preserving and covering certain metals and alloys of metals.*"—March 3; six months.

JAMES HORNE, of Clapham Common, Esquire, for "*improvements in the stuffing-boxes of lift pumps.*"—March 3; six months.

JOSEPH CLISILD DANIELL, of Limpley Stoke, Bradford, in the county of Wilts, for "*an improved method of preparing shoot or weft to be used in weaving woollen cloth and cloths made of wool and other materials.*"—March 3; sfx months.

JOHN RANGELEY, of Camberwell, Gentleman, for "*improvements in the construction of railways, and in the means of applying power to propelling carriages and machinery.*"—March 3; six months.

WILLIAM CRAIG, of Glasgow, Engineer, and WILLIAM DOUGLAS SHARP, of Stanley, Perthshire, Engineer, for "*certain improvements in machinery for preparing, spinning, and doubling cotton, flax, wool, and other fibrous substances.*"—March 3; six months.

JOSEPH NEWTON, of High Bridge Mill, York, Manufacturer of Fancy Cloths, and GEORGE COLLIER, of the same place, Mechanic, for "*an improvement in looms, for the weaving of figured or twilled fabrics.*"—March 4; six months.

JOSEPH BOWER, of Hunslet, York, Soda Ash Manufacturer, for "*certain improvement in the manufacture of carbonate of soda.*"—March 4; six months.

CHARLES ALEXANDER PELLERIN, of Leicester Square, Gentleman, for "*improvements in wind and stringed musical instruments.*" Communicated by a foreigner residing abroad.—March 4; six months.

CHARLES KOBER, of Leadenhall Street, Cloth Manufacturer, for "*improvements in fixing colour in cloth.*"—March 7; six months.

CAROLINE JULIA SOPHIA COX, of Addison Road, Kensington, Spinster, for "*an improved mode of fastening and uniting the edges of the divided parts of shoes, boots, bandages, packages, and other articles of dress or utility.*"—March 7; two months.

JOSEPH ATKINSON, of Roundhill, York, Farmer, for "*improvements in thrashing and winnowing-machine.*"—March 7; six months.

ROBERT MOLYNEUX, of Southampton Row, Chronometer Maker, for "*an improvement or improvements in chronometers.*"—March 7; six months.

William Matlby, Junior, of Mile End, Chemist, and Richard Cuerton, Junior, of Percy Street, Brass Founder, for "*improvements in extracting and concentrating the colour, tanning, and other matter contained in vegetable and animal substances.*"—March 7; six months.

Luke Hebert, of Birmingham, Civil Engineer, for "*improvements in the manufacture of cofered spades and shovels, soughing and grafting tools, and other implements of a like nature.*"—March 7; six months.

Hayward Tyler, of Milton Street, Cripplegate, Engineer, for "*certain improvements in machinery or apparatus for impregnating liquids with gas, including bottles for retaining, keeping, and preserving liquids so impregnated, also in the manner of filling and closing such bottles.*"—March 7; six months.

James Knowles, of Little Bolton, Lancashire, Coal Merchant, for "*an improved arrangement of apparatus for regulating the supply of water to steam boilers.*"—March 10; four months.

George Gwynne, of Portland Terrace, Regent's Park, Gentleman, for "*improvements in the manufacture of candles, and in operating upon oils and fats.*"—March 10; six months.

William Forrester, of Barrhead, Renfrew, Manager, for "*certain improvements in sizing, starching, dressing, and otherwise preparing warps for weaving fabrics, and on the machinery and apparatus therewith connected.*"—March 11; six months.

Thomas Peel, of Bread Street, Cheapside, Gentleman, for "*certain improvements in steam engines.*" Communicated by a foreigner residing abroad.—March 11; six months.

Richard Smith and Richard Hacking, of Bury, Lancaster, Machine Makers, for "*certain improvements in machinery and apparatus for drawing, slubbing, roving, and spinning cotton, wool, flax, silk, and other fibrous substances.*"—March 13; six months.

Etienne Robert Gaubert, of Paris, Professor of Mathematics, for "*certain improvements in machinery or apparatus for distributing types or other typographical characters into proper receptac.es, and placing the same in order for setting up after being used in printing.*"—March 13; six months.

James Hadden Young, of Lille, in the kingdom of France, and Adrian Delcombe, of Lille aforesaid, for "*an improved mode of setting up types.*"—March 13; six months.

Robert Varicas, of Burton Crescent, Surgeon, for "*improvements in rendering fabrics and leather waterproof.*"—March 16; six months.

William Crofts, of Radford, Nottingham, Machine Maker, for "*improvements in machinery for the purpose of making figured or ornamented bobbin net or twist lace, and other ornamental fabrics, looped or woven.*"—March 16; six months.

Jean Francois Victor Fabien, of King William Street, London, for "*improvements in rotary engines to be worked by steam or other fluids.*"—March 16; six months.

Thomas Craddock, of Broadheath, Radnor, Farmer, for "*a certain improvement or improvements in steam engines and steam boilers.*"—March 16; six months.

Richard Smith and Richard Hacking, of Bury, Lancaster, Machine Makers, for "*certain improvements in machinery for spinning cotton and other fibrous substances.*"—March 16; six months.

Isham Baggs, of Cheltenham, Gentleman for "*improvements in engraving, which improvements are applicable to lithography.*"—March 17; six months.

Moses Poole, of Lincoln's Inn, Gentleman, for "*improvements in producing and preparing leys for soap making, and in the manufacture of soap.*" Communicated by a foreigner residing abroad.—March 17; six months.

Samuel Seaward, of the Canal Iron works, Poplar, Engineer, for "*certain improvements in the construction of steam engines and in the application of steam engines to propelling ships and other vessels.*"—March 17; six months.

Sir William Burnett, Knight, of Somerset House, for "*improvements in preserving animal, woollen, and other fibrous substances from decay.*"—March 19; six months.

John Jackson, of Manchester, Nail and Bolt Manufacturer for "*certain improvements in the manufacture of nails, nuts, bolts, and rivets.*"—March 19; six months.

Thomas Sterling, of Limehouse, Patentee of the "rapid filterer" for "*improvements in the manufacture of fuel.*"—March 20; six months.

Francis William Gerish, of East Road, City Road, Patent Hinge Maker, for "*improvements in locks and keys and other fastenings for doors, drawings, and other such purposes.*"—March 20; six months.

Charles Keene, of Sussex Place, Regent's Park, Gentleman, for "*improvements in producing surfaces on leather and fabrics.* Communicated by a foreigner residing abroad.—March 23; six months.

William Newton, of Chancery Lane, Civil Engineer, for "*certain improvements in the strengthening and preserving of ligneous and textile substances.* Communicated by a foreigner residing abroad.—March 23; six months.

Samuel Hill, of Sloane Street, Chelsea, Gentleman, for "*improvements in the making of bread and biscuits.*"—March 25; six months.

Elhanan Bicknell, of Newington Butts, Surrey, Merchant, for "*improvements in separating the solid from the liquid parts of tallow, and other fatty matters.*" Communicated by a foreigner residing abroad.—March 25; six months.

William Palmer, of Sutton Street, Clerkenwell, for "*improvements in the manufacture of candles, and in apparatus for applying light.*"—March 25; six months.

Henry Smith, of Birmingham, Lamp Manufacturer, for "*improvements in gas burners, and in lamps.*"—March 25; six months.

George Richards Elkington and Henry Elkington, of Birmingham, for "*improvements in coating, covering, or plating certain metals.*"—March 25; six months.

Joseph Crosfield, of Warrington, Soap Maker, for "*certain improvements in the manufacture of plate glass.*"—March 25; six months.

Samuel Knight, of Woodhouse Mills, Lancaster, Bleacher, for "*certain improvements in machinery or apparatus for boiling, bleeching, or scouring, for the purpose of preparing and assisting the process of bleeching and dyeing cotton and linen, and other fabrics and fibrous substances.*"—March 25; six months.

James Hay, of Belton, Haddington, Scotland, Captain in the Royal Navy, for "*an improved plough, which he entitles the Belton plough.*"—March 25; six months.

Henry Philip Rouquette, of Norfolk Street, Strand, Merchant, for "*a new pigment.*" Communicated by a foreigner residing abroad.—March 25; four months.

James Sabberton, of Great Pultney Street, Golden Square, Tailor, for "*a fastening to attach straps to the bottoms of trousers.*"—March 26; two months.

Alexander Southwood Stocker, of Birmingham, Manufacturer, for "*certain improvements in manufacturing tubing or tubes, which are applicable to gas and other purposes.*"—March 27; six months.

Richard Prosser, of Cherry Street, Birmingham, Civil Engineer, for "*certain improvements in machinery or apparatus for manufacturing pipes.*"—March 27; six months.

Henry Kirk, of Upper Norton Street, Portland Place, Merchant, for "*improvements in the application of a substance or composition as a substitute for ice for skating and sliding purposes, part of which improvements may also be employed in the manufacture of ornamental slabs and mouldings.*"—March 28; six months.

John Bethell, of St. John's Hill, Wandsworth, Gentleman, for "*improvements in treating and preparing certain oils and fatty matters.*"—March 28; six months.

ERRATUM.

In Mr. Leeds Chronological Table of Architects, page 113 of the present number, the works of the second architect are omitted, it should stand thus. 1708, Mansard, Jules Hardouin, 1647,—*works*, Palace of Versailles; Dome of the Invalides, Paris; &c.

TO CORRESPONDENTS.

Mr. Spencer's *communication is unavoidably postponed until next month.*

P. P. E.'s *scheme for propelling canal boats we are fearful is impracticable, however, we will reconsider it before the next number appears.*

X. Y. Z. Glasgow. *We shall feel much pleasure to record in the Journal, the many improvements that are going on in Glasgow, if our correspondent will take the trouble to see some of the architects of the North and collect information for us, we shall be obliged.*

Mr. Thorold's *design for a frame of a steam engine possesses considerable merit for its compactness, as there is no novelty in the construction of the machinery, we cannot afford space for the design at this busy season of the year.*

R. W. T. and P. B.'s *communications on railway curves must stand over for the present, as we have already devoted so much space to that subject.*

Design of Huddersfield College by J. P. Pritchet, *architect, will appear in an early number.*

—— *We shall be glad to receive his proffered communication, we cannot hear from him too often.*

H.'s *design has appeared in another publication.*

Report on the plans for preventing accidents on board of steam vessels, and Dr. Charles Schafhaeutel's report on Playfair's boiler will be noticed next month.

To our correspondent at New York we return many thanks for his exertions on our behalf.

We are happy to find by the numerous letters we have received that our advocacy in the cause of Steam Navigation meets with the approbation of our subscribers.

We recommend a correspondent, his signature we forget, to read the Fable of the Miller.

Δ *We are obliged for his letter, we have long been aware of the sinister working of the individual alluded to—he is too contemptible for our notice, "every dog has his day." We feel ourselves independent of all parties.*

The Cinque Ports *reply to our correspondent* E. *on the recessions and encroachments of the sea will appear next month, together with a communication from* NOTA, *on the same subject.*

Communications are requested to be addressed to "The Editor of the Civil Engineer and Architect's Journal," *No.* 11, *Parliament Street, Westminster.*

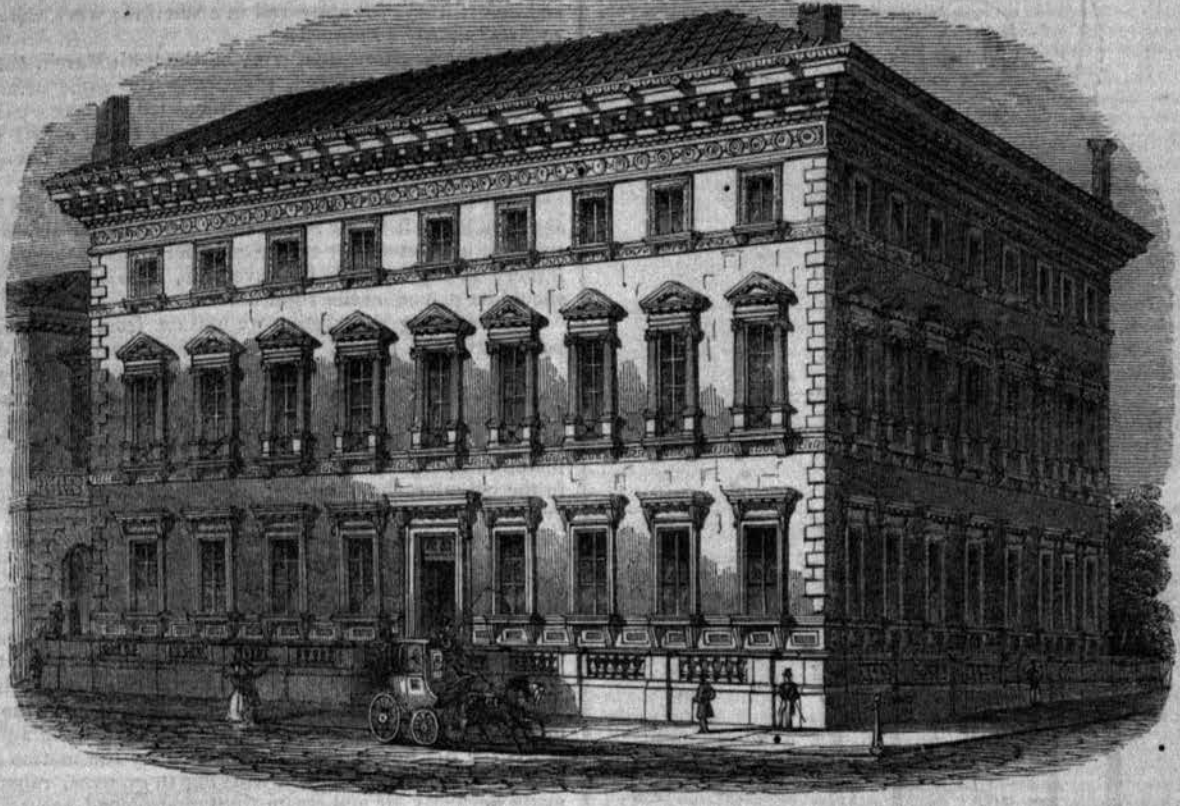
Books for review must be sent early in the month, communications on or before the 20th (if with wood-cuts, earlier), and advertisements on or before the 25th instant.

The First Volume may be had, bound in cloth and lettered in gold, Price 17*s.*

⁂ The Second Volume may also be had, Price 20*s.*

THE REFORM CLUB-HOUSE, PALL MALL.

CHARLES BARRY, R.A., ARCHITECT.



WHAT can be said about club-houses? Their friends are silenced by their success, and their enemies cannot contend against them. Hercules might have given up his club, but the aristocracy are determined not to follow his example. Their merits and demerits are beyond our control,—one only fact we have to deal with, and that is their rapid increase. The palaces have disappeared or have been eclipsed, and the south of Pall Mall is covered with an almost uninterrupted line of temples in honour of the social principle. If the grandeur of our commercial edifices strikes the foreigner with wonder, or if he considers our parks and squares as worthy rivals of his alleys of orange trees, how can he fail to pass without notice these personifications of national characteristics. The foreigner may justly marvel to see the palace eclipsed before the shrine of Mammon, but he must be still more astonished to see the hospital front of St. James's shrinking back from the grandeur of its unroyal neighbours. The principle of association is the foundation of civilization, and the English race are influenced by it more than any other. We are Napoleon's nation of shopkeepers, mechanics and stock-jobbers to the fullest extent, who take out our amusements in shares, and raise a joint fund to provide domestic comfort. Pall Mall is the true House of Commons of the nation—here every political principle is represented, and every shade of society has its point of reunion. In this street of palaces, unique in Europe, one of the most striking is the subject of our present notice.

For the view of this building we are indebted to the *Literary World*, of whose embellishments it may be considered a very fair specimen,—one certainly greatly superior to any thing to be met with in similar publications. With regard to the structure itself, we shall not now attempt to enter into any architectural description of it, reserving such notice till we have the opportunity of rendering it complete; and shall therefore at present only observe that the Reform Clubhouse is the most perfect and imposing specimen of Italian architecture in the metropolis,—reserving, however, to ourselves, our admiration for the Garden-façade of the Travellers, as the most elegant and piquant example of that style, upon a lesser scale. In this new work of Mr. Barry's we perceive extreme simplicity and unity of design combined with a very unusual degree of richness,—an *astylar* (columnless,) with more of architectural expression than is generally produced by a display of columns forming a principal order. The breadth of the piers or spaces between the windows contributes not a little to that repose which is so essential to simplicity, and hardly less so to stateliness. The string courses are particularly beautiful parts in the design, while the cornicione gives an extraordinary air of majesty and grandeur to the whole.

It is the largest and most commodious of any of the club-houses in the metropolis: the length of the front is 120 feet, exclusive of the entrance between the Travellers' Club-house and the main building, which is fifteen; making, in all, a frontage of 135 feet. The depth of the main building is 104 ft. 6 in.; the height of the cornice from the pavement, is about sixty-eight feet.

The roof is covered with Italian tiles, manufactured expressly for this building, by Messrs. Rutledge and Keene, of the Belvedere road. The whole of the building is faced with Portland stone, it is a very fine specimen of masonry, and does credit to the contractors, Messrs. Grisell and Peto. We must not omit to mention the scientific manner in which the building was erected; a scaffolding of considerable strength was constructed of timber, and on the top was laid a railway, upon which was worked a traversing crane that could be moved along the building either longitudinally or transversely: by this means the stones were raised from the ground and placed on the wall with very little labour to the mason, who only had to adjust the bed and lay the stone. We perceive that Messrs. Grisell and Peto are about to adopt the same plan for the new Houses of Parliament, by which means they will save very considerably in the price of labour.

BRODERIP'S TROUGH OR TRUNK ENGINE.

Fig. 1.—Section.

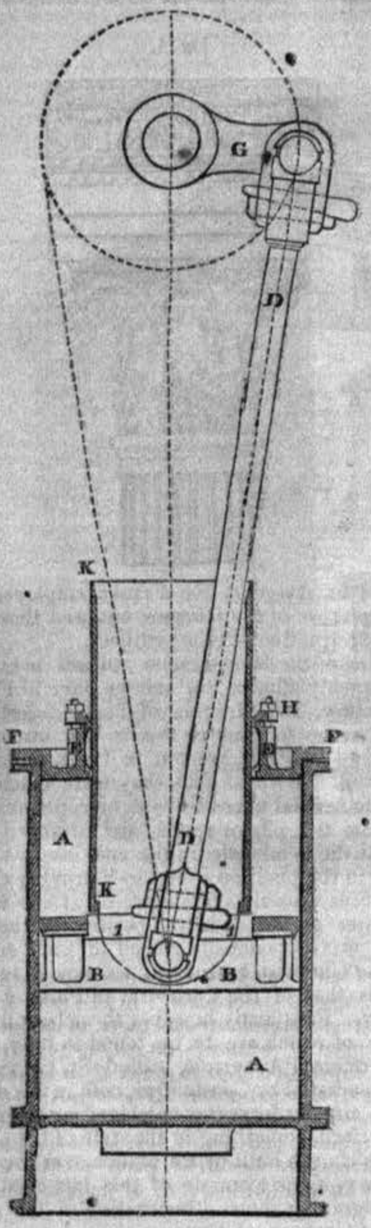
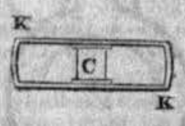


Fig. 2.—Section f Casing and Centre.



IN consequence of the late discussion at the meeting of the Great Western Steam Ship Company at Bristol, relative to the intended introduction of "Humphrys' Patent Trunk Steam Engine," for the new iron steam ship now building at Bristol. We felt desirous of obtaining a drawing and some particulars relative to it: upon making enquiries among our scientific friends, we were much surprised to find that a similar engine had been patented by another party nearly seven years antecedent to the patent of Mr. Humphrys; and was invented by the late Mr. Charles Broderip of Spring Gardens, a gentleman who was well known to the scientific world as a clever engineer and scientific man. Upwards of eighteen years ago he equipped a steam vessel called the "Tartar," with which he made a voyage into the Bay of Biscay and back, and by this spirited proceeding was the first person to demonstrate the practicability of sending steam vessels across that tempestuous bay, which, till then, had never been attempted.

He afterwards invented the application of a casing or trunk attached to the piston, by the use of which, he was enabled to connect the piston rod with the crank direct, as shewn in the accompanying drawing; he, however, died shortly afterwards, and his executor Col. D'Arcy took out letters patent for the invention, dated Nov. 29th, 1828, and a sketch and description of it appeared in a scientific work called the "Journal of Arts" shortly afterwards.

Some years afterwards, viz., on the 28th March, 1835, Mr. Francis Humphrys again patented, identically the same arrangement of the steam engine, and subsequently proceeded to make a pair of engines on this principle, that were fitted to a steam vessel called the "Dartford" which ran for a short time, but which it is stated, have since failed in the cylinders by the angular friction of the pistons. We shall now proceed to give a description of the engine as specified by both parties, and then leave it to our readers to judge how far Mr. Humphrys is entitled to his patent, or can be considered as the *original inventor*, for if there be any merit in the invention, it is only right that the saddle should be placed on the right horse.

The following description we extract from the specification of the patent granted to Col. D'Arcy:—The specification describes other improvements besides the one in question; one of them was for a *sliding stuffing box*, "the piston rod connected at one end to the piston, and at the other end to the crank of the engine without the intervention of any cross head, side rods, guide frame or parallel motion to keep the piston in a perpendicular position whilst it is ascending and descending in the cylinder, the improved method of connecting the piston of any cylinder used in a steam engine to its rod is by means of any convenient joint, or by a ball and socket which will allow the piston rod to oscillate or yield to the motion of its crank without altering the vertical or horizontal position of the piston, whilst acting either in a cylinder placed vertically or horizontally as circumstances may require; and by the introduction of the sliding stuffing box, I am enabled to apply the oscillating piston." The specification then proceeds to describe this invention by a reference to the drawings accompanying the specification. A A the cylinder, B B the piston, C C the centre of the joint of piston into which the joint of the piston rod D D is fitted and united; D D shows the rod forming its greatest angle by the motion of the crank G; E E the sliding stuffing box working in grooves, rabets or dovetails, made perfectly air and steam tight, and placed securely on the top of the cylinder cover F F. Instead of the sliding stuffing box, the patentee in some cases substitutes "*the trough or socket* K K" (showed in the annexed engravings) "firmly connected to the piston, and which trough or socket must be made hollow and of sufficient capacity to allow the piston rod D D to oscillate freely in its width, thickness, and area, so that in its transverse, through the fixed stuffing box E E, and by the gland H, the trough or socket K K may be rendered as securely air and steam tight in its connection with the cylinder A A, as if it was a cylindrical piston rod."

We shall now give some extracts from the specification of the patent granted to *Mr. Francis Humphrys*: we did not consider it necessary to give a drawing, as it is so identically like the above.

The letters in italics within parenthesis, we have introduced, they refer to the above engraving; the other letters are as they appear in Mr. Humphry's specification. "A A is the cylinder, B B the working piston, C (*G*) the crank, D D (*K K*) a steam tight casing or trunk of a rectangular form rounded at each end, which is permanently attached to the piston in such a manner that the axis of the one shall correspond exactly with the axis of the other, and which casing works up and down with the piston, E E (*F F*) is the lid or cover of the cylinder A A, G G (*E E*) the stuffing box which is made to fit the outside of the casing or trunk D D (*K K*) instead of as usual fitting the piston rod." In the concluding part of the specification, Mr. Humphrys states "that what I claim as my invention is the addition, to the pistons of steam engines, of a steam tight casing or trunk permanently affixed thereto, and working up and down therewith, and the employment of a connecting rod passing from the working piston to the crank through such steam tight casing or trunk, both in the same manner herein before specified; by means of which contrivance, the reciprocating motion of the pistons is resolved into a rotary motion without the intervention of the beams, cross heads and other auxiliary appendages in common use."

MEDIEVAL ARCHITECTURE IN FRANCE.—No. 1.

Whatever may be the opinions of individuals with regard to the merits of the Gothic style, it has so strong a hold on our sympathies, and so many advocates and supporters, that it can neither be neglected in a professional point of view, nor be decried as unimportant. As a branch of instruction its study is imperative, nor is it less so as coming within the domain of the antiquarian and the artist. Linking us, as this style does, in a common bond with surrounding nations, abounding in monuments not merely of local but of universal interest, its history in other countries affords not only pleasure, but becomes of value as tending to illustrate its progress here. To no other country does this apply more strongly than to France, where the architectural associations, like the political relations of the country for many centuries were interwoven with our own, springing from the same parent stock, and from time to time forming alliances which tended to keep up the mutual connection. At the same time the later and closer connection of France with the lower empire both in the east and the west has given rise to modifications which either never existed here, or of which the vestiges have become extinct, as in the case of the Romanesque and Byzantine Gothic, of which monuments are to be found there replete with the highest interest. It is for these reasons therefore that as we know that it would be acceptable to our readers we are induced to profit by the present opportunities afforded by French periodicals and other authorities of presenting a short account of the French Medieval styles in a familiar form.

In our second volume, page 193, will be found a valuable paper by Mr. Poynter, on the comparative chronology of English and French medieval architecture, founded on the investigations of M. Comon, of the Antiquarian Society of Caen.

COMPARATIVE CHRONOLOGY OF FRENCH AND ENGLISH MEDIEVAL ARCHITECTURE.

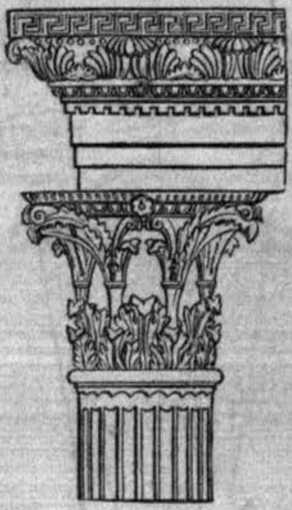
	950	Romanesque.		
	1000			
	1050			
Norman . . .	1100	Transition.		
	1150			
Early English . .	1200	Primordial Gothic.		
	1250		1st epoch.	Secondary or Gothique Rayonnant.
Decorated English .	1300			
	1350		2d epoch.	
Perpendicular . .	1400			
	1450		1st epoch.	Tertiary or Gothique Flamboyant.
	1500		2d epoch.	
	1550			

Taking this as our basis, the first style to which our attention is directed is the Romanesque, a style of which we have no example in this country.

THE ROMANESQUE STYLE.

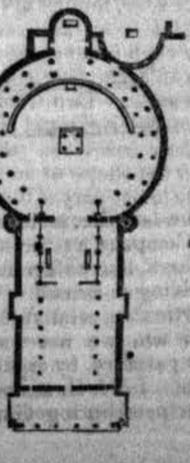
Applying the term of Romanesque style to those monuments imitated more directly from Roman architecture, we find a variety of specimens erected between the fifth and twelfth centuries bearing all the impress of their origin, and throwing much light on the history of the art. It was only about the fifth century after several invasions of the barbarous hordes, that sufficient tranquillity was restored in France to allow of the erection of new edifices, and of the repair of the old ones. The conversion of the Franks under Clovis to Christianity, created a necessity for buildings suitable to the new form of worship, to which the Roman temples were ill adapted. Instead of narrow sanctuaries secured by thick walls, the ceremonies of Christianity required large covered buildings, in which the congregation could participate in the services. It seems that under these circumstances the architects of that period sought for the type of their designs in the ancient synagogues of the Jews, and the civil basilicas of the Greeks and Romans. To the former they were naturally led by tradition and association, while in the latter they found a conveniency of disposition suitable to the extended wants of large communities. Thus were the caves in which the early Christian sought refuge, supplanted by the new edifices which from being built at Constantinople and Rome, served as models to other Christian countries. Hiding from persecution it was only in caves and in the hollows of rocks that the first votaries could worship in peace, and yet even in these places of banishment they had already introduced greater pretension in the disposition. At Montmajour, near Arles, one grotto church is laid out with two parallel naves, while in that fine specimen of a primitive temple at Sutrium, in Etruria, the space formed in the rock is divided into a vestibule, a nave divided by pillars so as to form side aisles, and a sanctuary. With greater liberty of worship more display was aimed at, and rude attempts were made to rival the labours of the past. In these essays it was natural that the relics of Roman art should be referred to as models, and plundered for materials, although as they could neither appropriate Roman genius nor transfer Roman skill, they necessarily fell behind their masters in success. Who can mistake the source, whence the annexed entablature and capital is derived, and many as strong can be adduced. Thus also the details of the order in the porch of the Cathedral at Avignon, the Franks employed not only bricks similar in form to those of the Romans, but used those which they obtained from the destruction of other edifices.

Fig. 1.



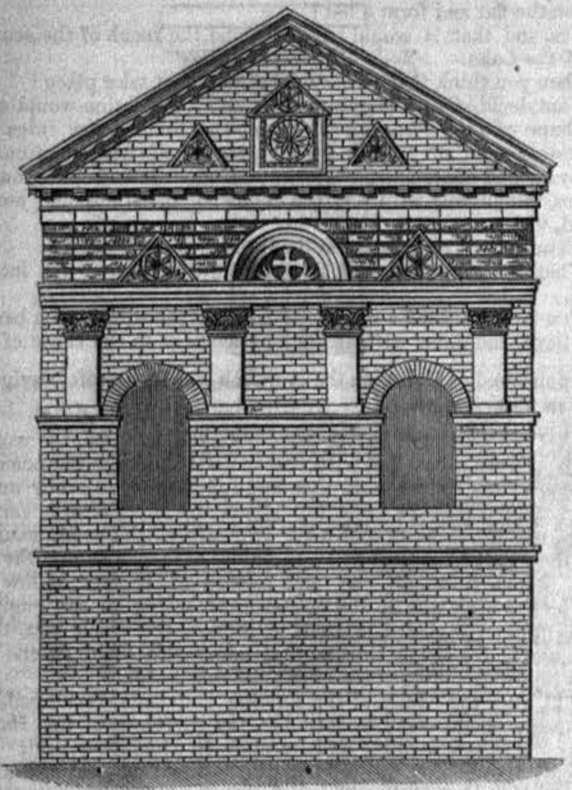
The ground plan of the Romanesque edifices is evidently referable to the sources already alluded to, and we have in Fortunatus, a poet of the sixth century, and Gregory of Tours descriptions of several churches which serve to confirm this to the utmost extent. Such were the primitive basilicas erected in Paris, Tours, Clermont and other cities of Gaul. We find that they were spacious, of an oblong form, divided into several naves by rows of columns of marble, doubtless obtained from the pagan spoils, and arranged parallelly to the lateral walls. At the hemicycle in the end, used as a sanctuary, was placed the altar, in the position called in Vitruvius the tribune, which in Christian edifices was always single, or at one end only, while in those of an earlier period, as in the basilica of the Foro Trajano at Rome, a tribune was occasionally placed at each end. Of the early specimens of the Christian basilica, if we may so term it, one of the best preserved, is that of the Cathedral of Parenzo in Istria, built in the sixth century. Frequently however these buildings were of a circular form, many of which are to be found in Italy, while in France there is St. Germain l'Auxerrois, called St. Germain the Round: several were consecrated by Constantine, both in the east and the west. Occasionally the circular form was combined with square naves, of the kind before described, something in the style of the church of the Holy Sepulchre. The church built by Perpetuus over the tomb of St. Martin, near Tours, was a fine example of this last combination, and the accompanying engraving shows a restoration of the ground plan from the description of Gregory, of Tours.

Fig. 2.



The mode of construction was based on that of the Romans, the buildings being made either of Roman brick or as before observed of bricks of a similar form made at that time. The architects also frequently made use of brick and stone in conjunction, a favourite system with the Romans. This is the case with the Baptistry of Poitiers, and the church of the Basse Œuvre, at Beauvais. Although at first formed very simply, these buildings soon began to be richly decorated with gilt mosaics, splendid marbles, and luxuriant carvings. Stephen of Tournay describes the basilica of St. Genevieve at Paris, built by Clovis, and destroyed by the Normans, as being covered with mosaics both inside and out; and Fortunatus, calls the basilica of St. Germain des Prés, built by Childebert, the gilt house of Germain, being decorated with gilt mosaics, and with a bright metal roof.

Fig. 3.



The church of St. John at Poitiers, represented above, is considered as belonging to the sixth or seventh century, and was originally a baptistry, as is proved by the discovery of a great octagon basin in the centre, and used for baptism by immersion. This building has undergone many changes, but the genuine portion is sufficiently distinct to be easily recognized. A pediment of ancient proportions surmounts the façade, and mouldings of simple profile frame it in, and these corresponding to the pitch of the roof, are accompanied by incrustations of a semicircular shape. Large stones, cut in intaglio, and ornamented with rosettes, decorate the tympanum. The horizontal entablature which supports the pediment is complete, consisting of an architrave, frieze and cornice, which last is enriched with modillions. Below the entablature is a band or zone, formed of large stones and bricks placed alternately, in the midst is an arch composed of several concentric circles, projecting over each other; and in the centre of this arch is a Greek cross resting on an architrave, supported by short pilasters with capitals in the ancient style. Two triangles in stone, similar to those in the tympanum, are on the right and left of the arch. Between the pilasters and below their bases are two windows now circular, but which were formerly in the shape of arcades, lighting the interior. A string course divides the lower part of the front into two equal divisions, through which no door was made, as it was opposite to the entrance.

The buildings of the south of France belonging to this period wear more of the ancient physiognomy than those elsewhere, a circumstance to be attributed to the neighbourhood of the noble Roman ruins, many of which still exist. The Cathedral of Our Lady of Gifts, at Avignon, has a porch the date of which is not well known, but which may be referred to the eleventh century, from the introduction of the door of the church at the bottom, and from the situation of the steeple, which surmounts it. This porch carries a pediment, of which the pitch is still conformable to ancient tradition; the mouldings of the side cornices have disappeared; in the middle is a circular opening called by the Christian authors an *oculus* or eye. The pediment is supported by an entablature of bad proportions, but ornamented with details servilely imitated from Roman architecture. The entablature rests on two Corinthian columns, attached to the angles of the porch, shown in our first engraving, and so exactly imitating the Roman monuments in the country, as to lead at first view to the belief that they are of pagan origin. In fact the arcade like entry shows a great resemblance to those of the triumphal arches of Orange and St. Remy. The basement of the steeple is decorated with a row of columns quite in the Roman style.

Fig. 4.—Portal of the 11th century, of Our Lady of Gifts, the Cathedral of Avignon.

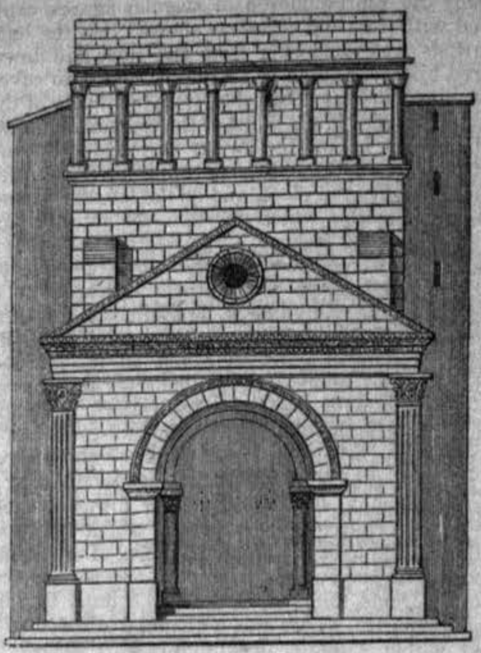
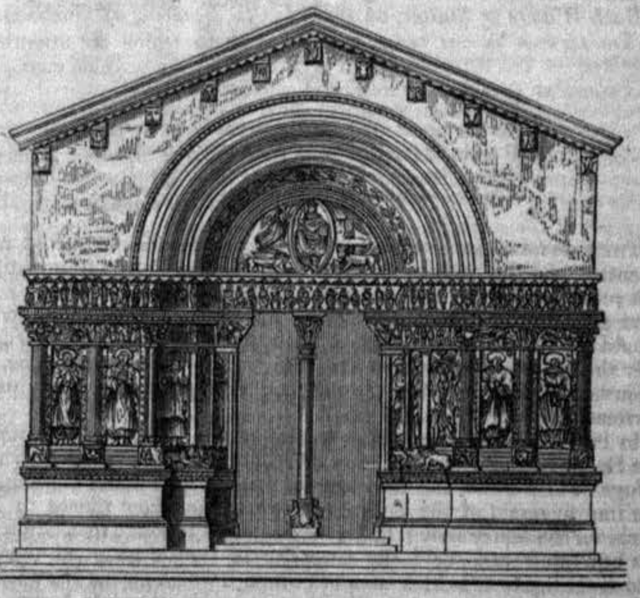


Fig. 5.—Church of St. Trophime, at Arles.



In the beginning of the twelfth century was erected the beautifu church of St. Trophimus, at Arles, represented above, and which seems a point of union between the Roman style and that of the middle ages proper. According to Gregory of Tours, this church, which in the sixth century was consecrated to St. Stephen, was only named after St. Trophimus in 1152, when the relics of the first bishop of Arles were placed in it. In the fifth century, this cathedral had been enriched with marbles from the theatre of Arles, which Saint Hilary had used for the decoration of Christian places of worship. It is surmounted by a pediment very slightly inclined, and the mouldings with which it is enriched, like most of the others in different parts of the porch, are still in the Roman style. Several details recall the traditions of the past, but already the representation of singular figures, capitals and bases, decorated with lions and chimeras, showed that the imagination of Christian artists was wandering from the rules laid down by the Greeks. Sacred history, related in sculpture, begins to cover all the zones of the façade, and images banished from the inside of the church take their stand without. In the midst of the tympanum formed by the springing of the arches, is God the Father surrounded by emblems of the Evangelists, above on the lintel are represented the Apostles, on the right of the Almighty the elect, and on the left the damned. Between the columns of marble which decorate the anterior parts of the door, are carved saints and bishops, a resurrection and other religious subjects. It may be observed that the arch already begins to assume something of the pointed shape, which it was afterwards to retain so long. The cloister of the church of St. Trophimus is one of the finest known; the arcades of its porticoes are supported by light columns surmounted with capitals of good style, and all the jutting columns which form the principal divisions of the galleries are decorated with statues of life-size, and with numerous bas reliefs, producing an admirable effect. Though the galleries of the cloister are of the same period as the portal, the other two are of the fifteenth century.

At Vaison, at the foot of Mount Ventoux, at Cavaillon, at Pontoise, at St. Paul-trois-Châteaux, and in many other towns of the south of France, are to be seen churches or chapels, in which it is easy to perceive that in the middle ages was formed a school of architecture, for a long time imbued with the ancient principles. If we add that in the royal church of St. Denis, founded in the fifth century by Saint Genevieve, and at Montmartre, where was a chapel dedicated to St. Denis are to be found marble capitals, decorated with the cross and other Christian emblems, and yet executed in the form and with the character of Roman capitals, it may be believed with good reason that the primitive churches of the Gauls showed like those of Italy, a filiation with Roman art, and that the tradition of classic forms was only lost after a certain number of generations, and through the influence of Byzantine, art imported from the east. At the same time we are able to trace the germs of the subsequent styles, for in Auvergne, Baron Taylor* found in a church of the Romanesque era, the arch decorated with the chevron moulding.

HARBOURS OF REFUGE.

Practical Observations on Harbours of Refuge, and on the effect of Back Waters or Sluices, as applied in the Scouring of Harbours.

By H. Barrett.

> "Give harbour room, and public ways extend,
> Let temples worthy of our God ascend,
> Bid the broad arch the dangerous flood restrain,
> The Mole projected break the roaring main,
> Back to its bound the subject sea command,
> And roll obedient rivers through the land."
>
> Cherbourg.

The subject of our harbours having for some time attracted much attention, and the recent appointment of Commissioners to investigate and report upon the state of the harbours on the south-east coast, having given rise to some discussion as to the proper principles which should govern the construction of harbours generally, I am induced to offer the following remarks as the result of my own experience and observation on this subject, continued through many years and in various parts of the world.

In 1826, and again in 1827, I was examined before a committee of the House of Commons on the subject of the then proposed harbour of refuge at Lowestoft, the connexion of the sea with Lake Lothing, and the improvement of the natural *river navigation* from thence to Norwich, for vessels drawing 12 feet water, so as to make that city a port *via* Lowestoft, and avoid the necessity of transhipment at the port into river lighters, as at Yarmouth, through which means Norwich has been for centuries supplied with coals and other sea-borne merchandize.

The following are extracts from the evidence given before the Committee on the occasion I have referred to, viz.

From the evidence of the Engineer.

"My proposition is to carry 12 feet at low water into the Lake, and I have no doubt on the outside it will scour deeper.

Q. You will always have 12 feet into the Lake?

A. Yes.

Q. What will the depths be at high water?

A. 20 feet. A vessel of 16 feet could enter during two thirds of the tide, *i.e.* at two thirds ebb.

Mr. Telford.

Q. Can you form an opinion as to the distance it will be from the shore where the bar will form?

A. There will be no bar—no deposit—next to none.

Q. Will the water from Lake Lothing take it away?

A. Yes; but I say there will be *no bar*, by this operation of the water, *none at all.*

Mr. Barrett.

Q. Do you think the sand carried out of the harbour would be lodged on the flat and form a bar?

A. Yes, and that it would lodge beyond the reach of the scouring water of the Lake.

Q. Then you think that an accumulation would take place?

A. I am decidedly of an opinion that an accumulation would occur, in the shape of a bar across the Harbour, and that at low tides even small vessels could not enter in consequence of the accumulation."

On my second examination before the Committee of the House of Commons, which was in 1827, the following questions and answers occurred, viz.

"*Q.* You have a clear opinion that a bar will be formed?

A. That *is* my opinion, and that the sluicing power will increase the evil.

Q. You have adopted a new hypothesis on the subject of a bar?

A. I have, and differ with all the engineers as to the cause of bars.

[See published evidence on the Norwich and Lowestoft Navigation, in sessions 1826 and 1827.]

The Act of Parliament having been obtained in 1827, the works of the Harbour were proceeded with, and in 1831 the Lake was connected with the sea; the sluices were then applied in order to scour out the newly excavated passage; but the immediate effect after a very few sluicings, was the formation of a *bar* opposite to the newly made entrance, the result being just as I had, in my evidence before the committees, stated it would be; and instead of 12 feet at low tide, and 20 feet at high tide at the entrance, according to the engineers' previous opinion as shown in their evidence, the result was that it became *nearly dry* at low tide, so that no vessels could enter. Such was the injurious consequence of the sluicing water.

In 1832, after the effects of the sluicing had been developed, a remonstrance was addressed by letter to the directors of the Harbour, by pilots and others residing at Lowestoft, in which they said,

"Deeply sensible of the advantages, national as well as local, attainable by the construction of an efficient harbour, at Lowestoft, we cannot but view the present with a feeling of regret, *its entrance encumbered with a shoal or bar.* We understand that the Commissioners for the Public Works are willing to lend £50,000 on mortgage, and we strongly recommend the appointment of an *experienced nautical engineer.*"

From the fatal error in the use of the sluicing waters, added to the mistaken mode of construction adopted, the whole undertaking became a failure, and the entire property, with piers, wharfs, buildings, engines, &c., have been recently submitted to public auction by the loan commissioners as mortgagees for £50,000 advanced by them; but the Harbour and all the property which had cost about £140,000, would not fetch £15,000, and were consequently bought in.

As far back as the year 1823, I published a pamphlet admonishing the public that it was impossible to construct a harbour of refuge on the site and by the method then proposed, and afterwards adopted; the result of this undertaking has fully verified my predictions, which, indeed, were founded on infallible data. Some time prior to that period, and before I developed my opinions on the certain effects of egress or sluicing waters, I had visited and observed upon various harbours in different parts of Europe, viz. St. Petersburgh, Nerve, Revel, Dantzick, Konnigsberg, Copenhagen, Elsineur, Norway, Hamburg, Tonningen, Amsterdam, Rotterdam, Ostend, Brest, Bayonne, Cadiz, Gibraltar, Malta, and on the coast of Africa; also many ports in England, Ireland, and Scotland, Shetland Islands, and the Orkneys.

In none of those places did I find any exception to the thesis which I have adopted relative to the injurious effects of egress, sluicing, or scouring waters, and I venture boldly to assert that in no part of the globe is there any exception, viz.

"*That wherever the water passes from the interior into the ocean with sufficient velocity to carry matter in suspension, and to cause a conflict-*

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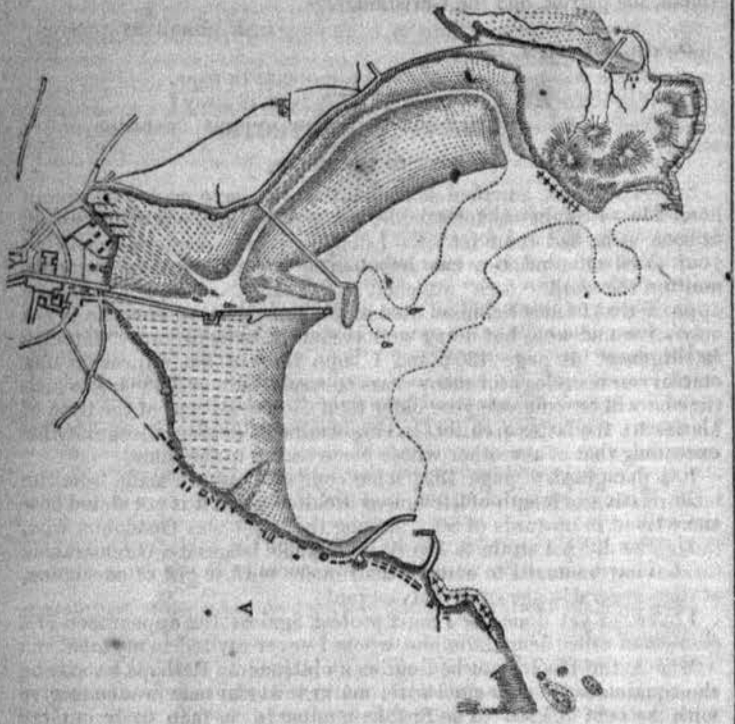
* Journal, vol. 2, p. 194.

ing action with the waters of the sea, there a shoal or bar is invariably formed, and that the greater the velocity of the egrees water, the larger will be the accumulation of shoal or bar. (See Fig. 1.)

Fig. 1.—Plan of Dublin Bay and Kingstown Harbour.



In various parts of the world, harbours at the entrance of rivers have been entirely blocked up and lost, by the operation of sluicing waters, and whether naturally, or artificially applied, the effects are similar. I may instance the following places, viz.

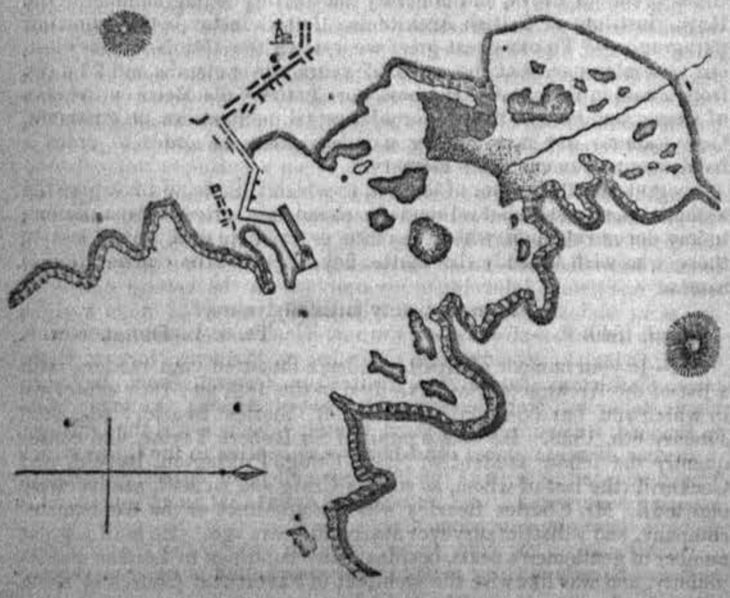
Wisbeach, Yarmouth (its north entrance), Winchelsea, Romney, Lowestoft, before referred to, Alexandria, the mouth of the Po, and of the Nile, and many others which might be enumerated.

The learned and great geologist, Baron Cuvier, states that "all attempts to improve the entrance to harbours by scouring waters have ever proved abortive, and brought science into contempt."

The futility of such attempts the examples here quoted demonstrate.

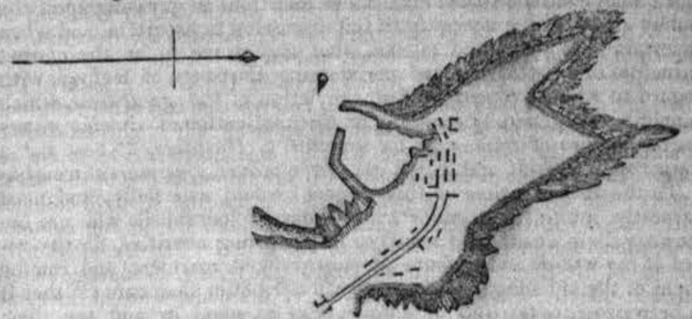
Labelye, who wrote in 1747, said, "*I advise all persons to be on their guard in attempts to construct locks or sluices on coasts, for besides the expence, they would be in danger of losing their harbours.*

Fig. 2.—Plan of Ardglass Harbour naturally formed.



My second proposition is that, "*wherever there is an absence of egress or sluicing waters, or where the water passes into the ocean so as not to convey matter in suspension, and not to cause a conflicting action with the waters of the ocean, there is no bar or shoal, or exterior accumulation;* and this proposition also applies equally to a natural harbour (see Fig. 2.) as it does to one of artificial construction. (See Fig. 3.)

Fig. 3.—Plan of Portrush Harbour, artificially formed.



Among the places I have visited, there are many that exemplify this proposition, the harbours being free from bars, and some of them sufficiently capacious to contain the whole British navy.

I will now refer to the evidence taken before a Committee of the House of Commons in 1836, on Dover Harbour, and on the means suggested by the Engineer for improving that harbour, who, in his evidence, says, "we are putting down pipes; and that is to carry away the *sluicing water*, and render it *more available by increasing its force*. The object has been that which every engineer who has been consulted is desirous to obtain, and it appears to me that *the remedy, although an expensive one, cannot fail to be complete.*"

Mr. Cubitt, (in answer to a question by the committee), said,

"Suppose that these works do not do so much as it is expected, for *successful they must be to a great degree*—"

The attempted improvement has turned out a failure. I will next give a short extract from the evidence of nautical and practical men, who were examined by the same Committee, and the result has shown that their opinions were better founded.

Mr. Hammond, a pilot, speaking of the plans, stated the alteration which had been made had not been effectual.

"*Q.* State your opinion to the Committee on the works now going on.

A. The bar will be more prejudicial and dangerous than it was before. If cleared one tide, it will be filled up the next.

Capt. Boxer, R.N., gave similar evidence, and said, "the works *will be a complete failure.*

The Honourable Captain (now Rear Admiral,) Elliot, gave similar evidence, and said, "*I consider, if the whole of the present plan was completed, the Harbour, as far as regards a Refuge Harbour, would be just as imperfect as it is at this moment.*" *

After reading the above evidence, it must be clear to every candid and reasoning mind, that whatever the right plan may be for the construction and improvement of harbours, that plan has not yet been hit upon by those engineers who have hitherto employed their talents in this department, and as the greatest national interests are involved in the question, and the safety and protection of our great maritime commerce, as, indeed, of our naval force itself, must mainly depend on the efficiency of Harbours, in which ready refuge may be found in time of need, no object can possess a higher claim upon public attention than Harbours of Refuge; on almost every part of our coasts the loss of property and of human lives have become a reflection on our national character. It is a lamentable truth, that while so many schemes of improvement or benevolence are daily attracting the patronage of the people of this kingdom, yet both the enterprize and the humanity of the same people have lain comparatively dormant on this subject, which more than any other affects our character and our interests as a great maritime nation.

In this branch of practical knowledge we are, it is to be regretted, much behind our continental neighbours, and prejudiciously shall we find it so in the event of a war with them.

In the session of 1839 I presented a petition to the House of Commons, praying to be heard by a committee on the subject of bars, and on the mode of constructing Harbours, free of bar or shoal at the entrance, and I was prepared to prove that the want of practical and nautical engineers was the principal cause of failure of the attempts to construct eligible Harbours, or of improving the existing Harbours, and further experience has strengthened this opinion.

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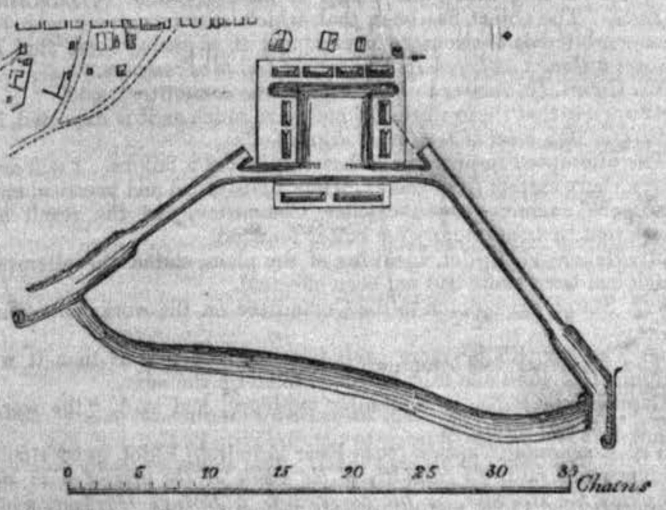
* See the published evidence on Dover Harbour. Session, 1836.

The petition was merely laid on the table, and my earnest desire to engage the attention of Parliament and of the public to a subject so deeply important, was on that occasion disappointed.

I am, however, not discouraged in my hope of ultimate success in the promulgation of my opinions, in which I have now the gratification to find myself countenanced by scientific, practical, and nautical men; and I shall continue to use my zealous exertions in pressing upon the public attention the necessity of full discussion to ascertain, and when ascertained to adopt and pursue, what may prove to be the correct principle of constructing and maintaining Harbours of Refuge, with regard to which I repeat my firm conviction of the *great error*, which cannot be too generally exposed, of the application of *sluicing waters for the purpose of improving the entrance to Harbours*, at best but a *temporary expedient*, and which has never proved a *permanent remedy*.

To the investigation of this subject I would especially, and most earnestly, invite those eminent and humane individuals who are bestowing their wealth, and influence in promoting charities, for the relief of the widow and orphans of shipwrecked mariners, and remind them of the old adage, "that prevention is better than cure;" that it is better to *save the lives of sailors*, than to stand by and see them *perish*, and then provide for their families who may be left destitute, and that Harbours of Refuge would be the means of preventing many of those calamities, no one can entertain a doubt; and that such Harbours can be successfully constructed in various places on our coast, where they are so much required, I will venture with confidence to affirm. (See Fig. 4.)

Fig. 4.—Plan for a Harbour of Refuge.



A Committee of the House of Commons was appointed in the session of 1836, for inquiring into the causes of shipwrecks, and they reported,

"That three millions of property, and one thousand human lives, are annually lost by shipwrecks on our coasts; and that the *want of efficient Harbours of Refuge* was one of the principal causes of these calamities.

The Committee of the General Ship Owners' Society, in their report, May, 1837, referring to the above report, stated that there is no Harbour of Refuge (that can be so called) from *the Firth of Forth to the Thames*,* and that the numerous casualties, unfortunately occurring in the navigation of the seas surrounding the British coast, naturally awaken the feelings of humanity; and that the loss of property from the River Tyne (only), amounted *annually* to £151,222, and of human lives in the same time, 170.

In 1836 there were 110 vessels stranded and wrecked on the Lowestoft and Yarmouth coast, and 197 vessels lost anchors and cables, many others sustained much damage. These losses (alone) may be estimated at £120,000, all of which falls on the ship owner or underwriter; but the incidental expences of a voyage, Harbour dues, &c., together with the ship-owners' profits, are paid by the *consumers* of the cargoes in the shape of freight.

The above sum would be sufficient to construct an eligible Harbour of Refuge on that coast; and the £3,000,000 annually lost by shipwreck, is adequate to construct Harbours on various parts of the coast, where they are so much required.

Under the impression, therefore, that Harbours of Refuge can be constructed, and ought to be constructed, I would invite the active assistance of all who can lend a hand in so good a work, for the attainment of which, I shall continue to devote my best exertions, myself *an old sailor*, I would, on behalf of sailors and their dependents, and for their safety, invite in so sacred a cause, the co-operation of the benevolent, the patriot, and the Christian.

H. Barrett.

London, 8th April, 1840.

TABLE OF ARCHITECTS.

[A NOTE TO THE EDITOR.]

Sir—I am quite horrified at finding that you have made me commit homicide—I might say infanticide, sending Schinkel out of the world, as soon as he had come into it. I don't say your printer's devil, but your devil of a printer, has *diabolically* and with malice prepense omitted the word "*born*" attached to the name, consequently it now appears that I fancy Schinkel died in the year 1781, whereas he is not only alive and well, but doing well as may be seen by your "Literary Intelligence" at page 130; and I hope he will not appear in any obituary or necrology for many years to come—not until 1881, at which time he will be only one year older than Clerisseau was at the time of his death; the latter architect having attained a degree of longevity far exceeding that of any other whose name occurs in the table.

In a paragraph of page 132, some computations are made from the table relative to length of life among architects, but it is not stated how many lived to upwards of 80. Among the latter was Gondouin, who, though he did not attain to a very remarkable longevity, is remarkable for having ventured to commit matrimony with a girl of seventeen, at the venerable age of seventy-seven!

I have not yet done, for I must protest against the appearance of a gentleman called Jean Radolphe, whom I never invited to my *table*, and who must therefore be turned out as an intruder. Perhaps he may be an acquaintance of your *diabolical*; and that worthy may be able to give some account of him. The first Jean appears, in fact, to be a mere nobody,—and so also does Gerstenburgh of whom it should have been recorded that he was professor of Civil Architecture at Jeva, and author of several publications, but principally on surveying, and, therefore, has but little right to make his appearance among the company he does.

And now feel relieved: you may, therefore, present my hearty, if not good wishes to your dial, and believe me, &c.

W. H. L.

P.S.—I have just seen by a foreign journal that Albertolli, whose name stands at the end ot the table died last November, in his 98th year, consequently may be quoted as an instance of longevity. I also now perceive that Jean Radolphe, should have been attached to the name of Perronet, in the next line.

Sir—Among the Architects of the 18th century, a list of eleven was given in your last number; the Signor Albertolli was mentioned, the author not being sure whether he still existed. I received, a few weeks since, a letter dated 27th January last from his nephew and son-in-law the Signor Ferdinando Albertolli, professor of architectural ornament in the academy of Breva, and honorary and corresponding member of the Royal Institute of British Architects. In this letter is the following paragraph:—"To our great grief we lost, on the 15th November last, our venerable parent at the age of 97 years, three months and 21 days, from a cold in the chest. His best work is the Villa Melzi on the lake of Como, and he was the author of several publications on ornament. Our academy are now raising a subscription in order to erect a handsome monument to his memory."

I regret that the author of the list, to which I allude, did not give the authorities, upon which it is founded; an indispensable accompainiment, to any document upon which reliance is to be placed, and a loss to those who wish to study the matter beyond the bare enumeration of names.

I am, Sir, very faithfully yours,

April, 1840. Thos. L. Donaldson.

Sir—In your number of April, you have favoured your readers with a list of the Architects who have died in the 18th and 19th centuries, in which you have omitted the name of Charles Beazley, who died January 6th, 1829. He was a pupil of Sir Robert Taylor, and consequently the fellow student of Nash, Craig, Pilkington, Byfield, and Cockerill (the last of whom, as well as Craig and Byfield, are likewise omitted). Mr. Charles Beazley was the architect of the Goldsmiths' company, and a district surveyor nearly 50 years ago. He built a great number of gentlemen's seats, besides many buildings in London and its vicinity, and was likewise the architect of Faversham Church in Kent, which has been so generally admired.

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* Nor is there from the Thames to the Isle of Wight.

Feeling that it is perhaps impossible for your collector to know the names of all the deceased architects, I trust that you will attribute this letter to the sole motive by which it is dictated, namely, to add such information as may enable you to correct your list should you republish it.

I remain, Your most obedient Servant,
29, *Soho Square, April* 3, 1840. SAMUEL BEAZLEY.

We have received another communication from Mr. Webb, for which we are obliged, containing the names of some architects, which were omitted in the table; we shall, at some future opportunity, avail ourselves of this communication, together with others, and publish an additional table. Editor C. E. and A. Journal.

TEACHERS OF CIVIL ENGINEERING, ARCHITECTURE, &c!!

SIR—As your highly useful journal is devoted to the advancement of the professions you advocate, allow me to draw your attention to what I consider to be an evil of the greatest magnitude, and one which has done more to lower the profession, and to bring it into disrepute, than anything else that I am acquainted with. I allude to the proceedings of a certain class of persons, styling themselves "Architects and Surveyors," or "Civil Engineers," who disgrace the profession they claim by pretending to teach it *in a few lessons*. Such men should be held up to universal scorn and contempt, for they have ruined the profession while filling their own pockets, by a process little better than swindling. I will explain the manner in which they go to work. They first put a specious advertisement in the newspaper, headed "Offices for Surveying, Architecture, and Civil Engineering," and go on to state that *a few lessons* are all that is required to enable a person to practise on his own account!! Some deluded individual is sure to be allured by this specious advertisement, for unfortunately, wherever there are dupes, there are sure to be knaves to take advantage of them.

Such persons, (the dupes,) find to their cost, that the business of an Architect, or Surveyor, or Civil Engineer, is not *quite so easily* acquired as they were at first induced to imagine by their *disinterested* instructor: instead of *a few lessons*, therefore, occupying a few weeks only, they are persuaded to go on with the farce for a few months, or until the master-hand thinks they will bear plucking no longer. He then lets them go, assuring them that they are *quite competent* to undertake *any survey whatever*, whether for canal, railway, or turnpike-road, and, if asked, furnishes them with testimonials to that effect, The newly fledged surveyor, or whatever he may choose to call himself, delighted with his newly and so easily acquired profession, hastens to put his skill to the test, and for this purpose, perhaps, takes an extensive parish to survey at a low rate, one, perhaps, that has to obtain the commissioners' seal, and for which he will therefore not be paid until it is completed to their satisfaction, and to that of Capt. Dawson, no easy person to please. He commences his work with confidence, but, after a short time becomes involved in a labrynth of perplexity and error, from which he cannot extricate himself; he, therefore, hastens back to his mentor to relate his misfortunes, and is persuaded by the latter to take a *few more lessons*, or perhaps is induced to employ him to survey the parish, for which he takes care to charge the "honorary" surveyor, about five times as much as he is himself to receive for the parish when completed. If endowed with a sufficient stock of gullibility and cash, the latter accedes, and after expending perhaps a much larger sum than he would have done, if he had placed himself with a respectable surveyor in a regular manner, he at length acquires a sufficient knowledge of the business to enable him to get on by himself without making many more blunders. In many cases, however, the aspirant is disheartened with his first failure, and declines the honour of being further taken in by his preceptor.

This is the way, Sir, in which the pockets of the unwary are picked, and the profession of the surveyor brought into disrepute; and the same remarks apply also to that of architecture, which our *professor* professes also to teach in a few lessons!!

Really, the barefaced impudence of some men exceeds all bounds, and yet we see the advertisements of these *highly respectable* members of the profession almost daily in the newspapers, a sure sign that they find it to answer their purpose, which is to fill their pockets at the expense of others.

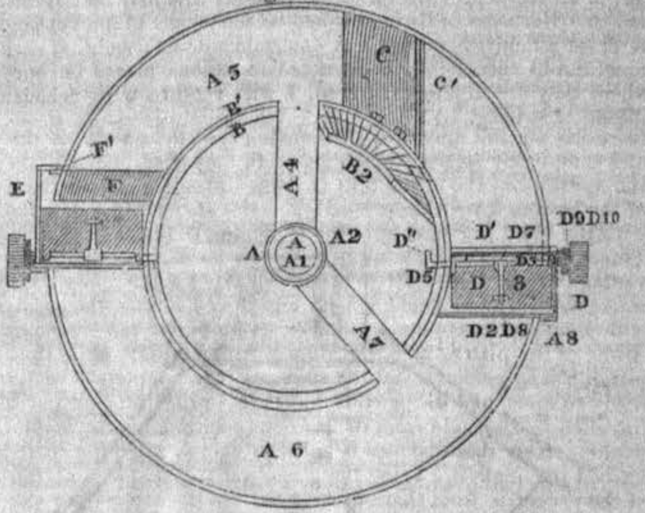
I think, that you would be really conferring a benefit upon the profession generally, and on the rising generation in particular, by drawing attention to the tricks of these advertising quacks, who are in general, persons of no kind of reputation or ability, and who are therefore quite unqualified to give instructions in the business they profess. By pointing out also the fallacy and utter absurdity of a person endeavouring to acquire *in a few lessons*, a profession in which a man's *whole life* is barely sufficient to enable him to acquire all the minutiæ of his art, and in which there is always *something new* to be learnt, you may be the means of preventing the inexperienced from falling into such an error, and into the clutches of our advertising *professors*. The profession is already overstocked with persons regularly educated, and perfectly competent to practise it, but it is too bad that they should be continually brought into collision with, and made to suffer for the ignorance and blunders of others calling themselves "Architects and Surveyors," or "Civil Engineers," on the strength of a few lessons received from parties nearly as ignorant as themselves, and who are no more qualified to practice the professions they pretend to teach, than I am qualified to fulfil the duties of Lord High Chancellor.

I have the honor to be, Sir,
London, April 17, 1840. ONE WHO HAS SUFFERED.

[We do not wonder that parties can be induced to think that civil engineering can be taught in a college, when there are those who believe that it can be required in a few lessons. What is to become of the hundreds of accomplished professors who are to be manufactured wholesale at the Gordon College?

MR. MOORE'S PATENT ROTARY ENGINE.

Fig. 1.



The following is a brief outline of this invention, taken from th specification.

A 5, A 6 is a hollow ring, or cylinder, with two pair of folding doors, D 3 and F, which open in the direction D, D 2, and F, F 1, and fall back into boxes to receive them. The doors of each pair open together by means of tooth wheels, and are closed again by coiled springs behind them, and afterwards pressed closely together by the elastic force of the steam, when the piston C has passed them. A, A 1 is a hollow axle, through one arm of which, at A, the steam enters, and passing through the tube A 4, just behind the piston, fills the space left between the piston C, and the folding doors F, next behind it. By its pressure on C, and confinement against the said folding doors, the piston (which is firmly connected with all the interior part A, A 2, &c.) and the said interior part revolve together in the fixed ring cylinder, A 5, A 6, in the direction C C'. As the piston C approaches the doors D 3, the beveled part B 2, acting on the ketch D 5, gradually opens the folding doors, which, after the piston has passed, close again by means of the coiled springs, and are kept tight by the steam issuing through A 4. Through A 7, A 1, all the steam or air in advance of the piston passes off, and leaves the front side of the piston with no more than the common pressure of the atmosphere, as in all other engines, to oppose the piston.

This is the principle of the machine, and of its action, but a variety of contrivances are introduced—shown by other diagrams we have not thought it needful to insert—for the purpose of meeting and overcoming any difficulties in the way, and of rendering the machine more perfect.—*Railway Magazine.*

Electro-Galvanism.—At a lecture delivered at the Boston Mechanics' Institute, on Friday the 13th ult., by Mr. H. R. Gilson, the curator, he exhibited a most ingenious and important application of electro-magnetism to practical purposes, by which he is enabled to take the casts requisite for sterotyping in copper. They are at present made in plaster of Paris, and are seldom absolutely perfect; but by this novel application of science to the arts, stereotype plates may be produced as perfect and sharp as the type from which they are taken.

GENERAL THEORY OF THE STEAM ENGINE.

By Aristides A. Mornay, Esq.

No. VI.

On the Action of the Steam in the Cylinder of a Steam Engine,

(Continued.)

We shall first consider the most simple case, namely, that of a low pressure condensing engine without expansion, and with the ordinary slide valve, as the action of this valve is more simple than any other for calculation.

On the subject of the slides we have to observe, that, although their motion is gradual and as slow as it can be, yet there is no loss of effect arising from this circumstance. We should not have thought it necessary to mention this fact here, as we stated it cursorily in our last paper, but we have since seen a paragraph in Tredgold's Treatise on the Steam Engine, where he asserts the contrary. This paragraph is at page 204, and runs thus:

"When valves, cocks, or sliders are to be moved to admit steam to a steam-engine, the motion should be as quick as circumstances will permit, so that the passages may be wholly opened or wholly closed at the proper time with the least delay; for it may be easily shown that a considerable loss of effect arises from valves opening or shutting with a slow motion."

Now the slide, when it has no travel, takes one half of the duration of the stroke to open, and the other half to shut the ports; and, as the eccentric is placed a quarter of a revolution in advance of the crank, the ports are full open when the piston is at the middle of the stroke, and completely closed at each end. If, however, we can show that the aperture of the steam port is always proportional to the velocity of the piston, it will be proved that the steam will follow the piston with the same pressure from the beginning to the end of the stroke. This will, however, only apply to the steam port as regards the disadvantage of the slow motion of the slide; for the more rapidly the waste steam can be made to pass into the condenser, the greater effect will obviously be obtained from the steam.* At the beginning of the stroke of the piston, then, the slide is in the middle of its stroke; the piston has no velocity, and the steam-port is completely shut, but just ready to open, and its aperture increases in the ratio of the distance travelled by the slide from its present position in the middle of its stroke. Now that distance is equal to $\epsilon \sin a$, when the shaft has described the angle a, ϵ being the eccentricity or distance of the centre of the eccentric from that of the shaft. In the same time the piston will have acquired the velocity $v \sin a$, if v is its velocity in the middle of the stroke. These two quantities evidently increase always in the same ratio, therefore the orifice of the steam-port is always sufficiently large to admit steam of the same elasticity as at the middle of the stroke of the piston, supposing no waste space to require filling with steam at the beginning of each stroke, and this is effected before the piston has described a sensible portion of its stroke, the steam having a much greater tendency to flow into nearly a vacuum than into steam of very little less than its own pressure.

In order to allow for the filling of the waste space with steam, we will suppose the slide, instead of having no lead, to have just so much as will allow that space to be filled with steam of the same elasticity as that in the steam-pipe, by the time the steam has arrived at the end of the cylinder, and is ready to begin its stroke, the aperture of the port being at the same time enlarged so much, that in the middle of the stroke of the piston it should be sufficient to allow the steam to follow the piston with the required elasticity. But, since this necessary lead of the slide and enlargement of the port are, as will be hereafter proved, excessively small, we shall omit to take them into consideration, merely assuming the effect for the sake of which these alterations were supposed, namely, that the waste space is already filled with steam of the same elastic force as that in the steam-pipe at the moment the piston commences its stroke.

Suppose now the piston in the middle of the stroke, in which case the steam port will be full open, and let the elastic force of the steam in the steam passages $= P$, that of the steam in the cylinder $= p$, the ratio of the area of the piston to that of the steam port $= m$, and $V =$ the mean velocity of the piston in feet per minute. Let it be required to determine p when all the other quantities are known.

In order to solve this problem, we have to find, *first*, the velocity of the steam through the port necessary to enable it, when expanded to the elastic force p, which it assumes in the cylinder, to follow the piston with the velocity $\frac{\pi V}{2}$ which the piston has attained in the middle of the stroke; *secondly*, the height of a column of steam of the elasticity P, which would give it that velocity, and *lastly*, the pressure of that column, which will be equal to the loss of pressure which the steam suffers in entering the cylinder.

In the first place, the velocity of the steam through the port, if it retained its density, would be $\frac{m \pi V}{2}$; but, since we suppose a loss of pressure, we must also assume a diminution of density; and, if we call v' and v, the relative volume of the steam in the steam passages and in the cylinder respectively, the velocity through the port will be $\frac{v' m \pi V}{2 v}$. The height due to this velocity is,

$$h = \frac{v'^2 m^2 \pi^2 V^2}{28{,}800\, g\, v^2},$$

and this is the height of the column of which the pressure is to be determined. This would evidently be known if we knew the height of the column whose weight is equivalent to the total elastic force P, which we shall therefore now endeavour to ascertain.

Let p and v be the elastic force and relative volume of steam at the temperature t, and p' and v' those of steam at the temperature t'; also let H be the height of a column of the former, whose weight is equivalent to its pressure p, and H′ the height of a column of the latter whose weight is equivalent to its pressure p'. It is evident that we must have

$$\frac{H'}{H} = \frac{P' v'}{P v}.$$

But we have also

$$\frac{P'}{P} = \frac{v (t' + 448)}{v' (t + 448)} = \frac{v T'}{v' T},$$

which value being substituted in the preceding equation, it becomes

$$\frac{H'}{H} = \frac{T'}{T}.$$

When $t = 212$, H is the height of the column of atmospheric steam equivalent to its elastic force, and H′ that of the column of steam at any other temperature t' equivalent to its elastic force p'. Assuming the density of water to be 1700 times that of atmospheric steam, and the pressure of the atmosphere to be equal to the weight of a column of water 34 feet high, the value of H will be 57800 feet, and we shall have

$$H' = \frac{57800}{660} T',$$

or, reducing the coefficient and dropping the accents,

$$H = 87{\cdot}57576\, T.$$

Since the value of P is supposed to be known, we can find that of T by referring to a table, so that we may consider H as already determined, and therefore make use of it in the determination of the loss of pressure $P - p$, which the steam suffers in entering the cylinder.

As the two columns H and h have the same density, their pressures are evidently proportional to their altitudes, therefore

$$\frac{P - p}{P} = \frac{h}{H},$$

whence

$$P - p = \frac{v'^2 m^2 \pi^2 V^2 P}{28800\, g\, v^2 H},$$

or, substituting for the constants π^2 and g their values, and for H its value 87·57576 T, as found above,

$$P - p = {\cdot}00000012156 \frac{v'^2 m^2 V^2}{v^2 T} P. \qquad (a)$$

We may be allowed to presume that the difference between v' and v in all cases which occur in practice is so trifling that the ratio $\frac{v'^2}{v^2}$ may, without any sensible error, be regarded as equal to unity, which will reduce the preceding equation to the following simpler one,

$$P - p = {\cdot}00000012156 \frac{m^2 V^2}{T} P. \qquad (b.)$$

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* In condensing engines, working with low pressure steam, the resistance of the waste steam is usually considered as equal to the pressure in the condenser; we shall show in a future paper that where the slide valve is used with no lead, the pressure of the waste steam on the piston is much greater than in the condenser during a considerable portion of the stroke.

To show numerically by how much the pressure p of the steam in the cylinder may fall short of P, which is its pressure in the steam passages, we shall apply these formulæ to one or two examples, when we shall also show that the error introduced by neglecting the difference between v' and v does not amount to so much as one hundredth part of a pound, whether the steam be used at a high or low pressure, provided the area of the steam passages be not excessively small, nor the velocity of the piston very great.

As a first example let $P = 14{\cdot}71$, $m = 25$, and $V = 240$. The temperature of the steam in the passages is in this case 212 degrees, which gives $T = 660$, and $v' = 1700$.

Having substituted these values, we find

$$P - p = {\cdot}00663\,P = {\cdot}0975 \text{ lb.},$$

whence

$$p = {\cdot}99337\,P = 14{\cdot}6125 \text{ lbs.}$$

The relative volume of steam of this elastic force is 1711, which makes $\frac{v'^2}{v^2} = {\cdot}9872$, and if we multiply the above value of $P - p$ by this fraction, we shall obtain

$$P - p = {\cdot}0963 \text{ lb.},$$

which gives

$$p = 14{\cdot}6137 \text{ lbs.},$$

which differs from the former value by no more than ·0012 lbs., which is a negligeable quantity.

As an example of excessively high pressure steam, let $P = 130{\cdot}93$, and m and V the same as in the former example. In this case we have $T = 798$ and $v' = 230{\cdot}9$.

From formula (*b*) we obtain

$$P - p = {\cdot}005484\,P = {\cdot}718 \text{ lb.}$$

whence

$$p = 130{\cdot}212 \text{ lbs.}$$

The relative volume of steam of this elastic force is 2321, so that $\frac{v'^2}{v^2} = {\cdot}9897$, and, multiplying by this fraction the value of $-p$ just obtained, the latter becomes

$$P - p = {\cdot}711 \text{ lbs.},$$

whence

$$p = 130{\cdot}219 \text{ lbs.}$$

The error introduced by neglecting the fraction $\frac{v'}{v''}$ is therefore also in this case too small to be worth taking account of, so that we may always content ourselves with formula (*b*), when we wish to ascertain the loss of pressure which the steam suffers in passing through the steam port into the cylinder of a steam engine.

On referring to equation (*b*), it will be seen that the loss of pressure which the steam suffers in passing through the port into the cylinder varies *directly* as the square of the velocity of the piston, and as the square of the ratio of the area of the piston to that of the steam port, and *inversely* as the number of degrees by which the temperature of the steam in the steam passages exceeds — 448 degrees Fahr., which shows that, the higher the pressure of the steam used, the less is the comparative loss in passing through the port, and, the greater the velocity of the piston, the larger the steam port must be in the same proportion, that the loss of pressure may be the same.

We assumed a rather considerable value for V in the above calculations, in order to show more satisfactorily how trifling is the error which can be committed in deducing the elastic force of the steam in the cylinder from that in the steam passages. By making $V = 210$ feet per minute, which is the speed usually given to the piston of an engine, instead of 240, which we assumed above, the value of $P - p$ will be reduced in the ratio of 210^2 to 240^2, or 49 to 64. When therefore the area of the steam port is one 25th part of that of the piston, and the mean velocity of the piston is about 210 feet per minute, we may assume, as an average for low pressure engines,

$$P - p = {\cdot}005\,P,$$

or

$$p = {\cdot}995\,P;$$

and for high pressure engines,

$$P - p = {\cdot}0046\,P,$$

or

$$p = {\cdot}9954\,P.$$

It is a very good plan to fix a steam guage on to the slide box, or steam pipe very near the cylinder, as that dispenses with the calculation of the loss of elastic force experienced by the steam during its passage through the steam pipe, before it arrives at the slide box.

When speaking of the lead of the slide necessary to allow the waste space at the end of the cylinder to be filled with steam before the beginning of the stroke of the piston, we said we should prove it to be excessively small. The calculation of the exact lead required for that purpose is very long and difficult, involving integrals of a very complicated nature; but it will answer our purpose equally well to prove it for a greater lead than necessary, for it will then be proved à fortiori for the necessary lead.

Let P be the elastic force and D the density of the steam in the steam pipe, and let H = the height of a column of the same steam whose weight is equivalent to its pressure. Also let p be the elastic force, and δ the density of the steam in the waste space when the port is open to a certain degree, α the area of the orifice at that moment, v the velocity of the steam through it, and q the volume of steam of the density D which has passed through the port, and let d be the density of the steam in the condenser, and consequently also in the waste space before the port has begun to open. In the case of non-condensing engines d is equal to the density of atmospheric steam, or 1. Also let c be the contents of the waste space, A the area of the piston, L the length of the stroke, and $\frac{1}{n}$ the ratio of the area of the steam port to that of the piston.

The height of the column of steam equivalent to the pressure $P - p$, to which the flowing of the steam through the port is due, is equal to $H\left(1 - \frac{p}{P}\right)$, the velocity will therefore be equal to

$$v = \sqrt{2\,g\,H\left(1 - \frac{p}{P}\right)}.$$

But this formula would lead to very complicated calculations, as we have already observed, for which reason we shall substitute the fraction $\frac{\delta}{D}$ for $\frac{p}{P}$, which will render the case less favourable; for the former being greater than the latter, the factor $\left(1 - \frac{\delta}{D}\right)$ is less than $\left(1 - \frac{p}{P}\right)$; wherefore also the value of v will be less after the substitution than before, and consequently the time required to raise the pressure of the steam in the waste space to the maximum which it attains in the cylinder will appear greater than it really is. If therefore we can prove this to be exceedingly short, it will be demonstrated à fortiori for the true time. We shall therefore assume, in place of the above equation

$$v = \sqrt{2\,g\,H}\,\sqrt{1 - \frac{\delta}{D}},$$

or

$$v = \sqrt{\frac{2\,g\,H}{D}}\,\sqrt{D - \delta}. \qquad (1.)$$

We have also between the variable quantities q and δ the following relation

$$c\,\delta = q\,D;$$

whence

$$q = \frac{c}{D}\,\delta,$$

And, by differentiation,

$$\text{dif. } q = \frac{c}{D}\,\text{dif. } \delta.$$

But we have also

$$\text{dif. } q = \alpha\,v\,\text{dif. } t,$$

where dif. t is the infinitely small space of time during which the infinitely small quantity of steam dif. q of the density D passes through the orifice α. These two equations, having their first members equal, give

$$\frac{c}{D}\,\text{dif. } \delta = \alpha\,v\,\text{dif. } t. \qquad (2.)$$

Let $b\,r$ represent the area of the steam port when full open, b being its constant length and r the greatest width to which it is opened by the eccentric, which is equal to the eccentricity of the latter; we shall then have, calling θ the angle described by the eccentric from the moment when the port began to open till its aperture had become equal to a,

$$\alpha = b\,r \sin\theta; \qquad (3.)$$

whence we obtain by differentiation

$$\text{dif. }\alpha = b\,r\cos\theta\ \text{dif. }\theta,$$

or

$$\text{dif. }\theta = \frac{\text{dif. }\alpha}{b\,r\cos\theta}.$$

But equation (3) gives

$$b\,r\cos\theta = \sqrt{b^2\,r^2 - \alpha^2},$$

which, being substituted, makes

$$\text{dif. }\theta = \frac{\text{dif. }\alpha}{\sqrt{b^2\,r^2 - \alpha^2}}.$$

And, if we call τ the duration of a single stroke of the piston, or half a revolution of the shaft, we shall also have

$$t = \frac{\theta}{\pi}\,\tau;$$

whence by differentiation

$$\text{dif. }t = \frac{\tau}{\pi}\ \text{dif. }\theta,$$

which becomes by substituting the value of dif. θ just found

$$\text{dif. }t = \frac{\tau}{\pi\,(b^2\,r^2 - \alpha^2)^{\frac{1}{2}}}\ \text{dif. }\alpha.$$

Substituting this value, as well as that of r given by equation (1), in equation (2), this latter becomes

$$\frac{\text{dif. }\delta}{(\mathrm{D} - \delta)^{\frac{1}{2}}} = \frac{\tau\sqrt{2\,g\,\mathrm{H\,D}}}{c\,\pi}\,\frac{\alpha\ \text{dif. }\alpha}{(b^2\,r^2 - \alpha^2)^{\frac{1}{2}}}. \qquad (4).$$

The greatest value which δ can acquire, being equal to the maximum density of the steam in the cylinder during the stroke of the piston, cannot be quite equal to D, but will not fall far short of it. On the other hand it is evident that, if we assume D as the maximum value of δ, the hypothesis will be unfavourable to our demonstration; we are therefore permitted to make it; and as the minimum value of δ is equal to d, we must integrate the first member of preceding equation between the limits $\delta = \mathrm{D}$ and $\delta = d$. The limits of the value of α in the second number are $\alpha = a$, the aperture of the port when δ has attianed its greatest value, and $\alpha = o$. We must therefore have

$$\int_d^{\mathrm{D}} \frac{\text{dif. }\delta}{(\mathrm{D}-\delta)^{\frac{1}{2}}} = \frac{\tau\sqrt{2g\,\mathrm{H\,D}}}{c\,\pi}\int_o^a \frac{\alpha\ \text{dif. }\alpha}{(b^2r^2 - \alpha^2)^{\frac{1}{2}}}. \qquad (5.)$$

In the first integral let $\mathrm{D} - \delta = x$; then dif. $\delta = -$ dif. x, and

$$\int_d^{\mathrm{D}} \frac{\text{dif. }\delta}{(\mathrm{D}-\delta)^{\frac{1}{2}}} = -\int_o^{\mathrm{D}-d} x^{-\frac{1}{2}}\ \text{dif. }x.$$

$$= -2\,(\mathrm{D} - d)^{\frac{1}{2}}.$$

In the second integral make

$$b^2\,r^2 - \alpha^2 = z.$$

By differentiation we obtain

$$\alpha\ \text{dif. }\alpha = -\tfrac{1}{2}\ \text{dif. }z.$$

We have, therefore,

$$\int^a \frac{\alpha\ \text{dif. }\alpha}{(b^2\,r^2 - \alpha^2)^{\frac{1}{2}}} = -\int_{b^2\,r^2 - a^2}^{b^2\,r^2} \frac{1}{2}\,z^{-\frac{1}{2}}\ \text{dif. }z.$$

$$= -\left[b\,r - (b^2r^2 - a^2)^{\frac{1}{2}}\right].$$

Substituting these values of the integrals in equation (5), we obtain

$$2\,(\mathrm{D} - d)^{\frac{1}{2}} = \frac{\tau\sqrt{2\,g\,\mathrm{H\,D}}}{c\,\tau}\left[b\,r - (b^2\,r^2 - a^2)^{\frac{1}{2}}\right],$$

and, substituting for a its value given by equation (3),

$$2\,(\mathrm{D} - d)^{\frac{1}{2}} = \frac{\tau\sqrt{2g\,\mathrm{H\,D}}}{c\,\pi}\left[b\,r - b\,r\,(1 - \text{im.}\,\theta^2)^{\frac{1}{2}}\right]$$

$$= \frac{b\,r\,\tau\sqrt{2\,g\,\mathrm{H\,D}}}{c\,\pi}\ \text{sim. }\theta;$$

whence we deduce

$$\text{sinv. }\theta = \frac{2\,c\,\pi\sqrt{\mathrm{D} - d}}{b\,r\,\tau\sqrt{2\,g\,\mathrm{H\,D}}};$$

or, putting for $b\,r$, which is the area of the steam port when full open, its value $\frac{\mathrm{A}}{n}$,

$$\text{sinv. }\theta = \frac{2\,n\,c\,\pi\sqrt{\mathrm{D} - d}}{\tau\,\mathrm{A}\sqrt{2\,g\,\mathrm{H\,D}}}.$$

Now $\frac{\mathrm{L}\ \text{sinv. }\theta}{2.}$ expresses the distance passed through by the piston while the shaft describes the angle θ round its axis, and consequently during the time the waste space is filling with steam, therefore, if we call l that distance, and $\frac{1}{\mathrm{S}}$ the ratio of the waste space c to the contents of the cylinder between the limits of the stroke, we shall have $c = \frac{\mathrm{A\,L,}}{\mathrm{S}}$ and

$$l = \frac{n\,\pi\,\mathrm{L}^2\sqrt{\mathrm{D} - d}}{\mathrm{S}\,\tau\sqrt{2\,g\,\mathrm{H\,D}}},$$

or

$$\frac{l}{\mathrm{L}} = \frac{n\,\pi\,\mathrm{L}\sqrt{\mathrm{D} - d}}{\mathrm{S}\,\tau\sqrt{2\,g\,\mathrm{H\,D}}} = \frac{n\,\pi\,\mathrm{L}\sqrt{1 - \frac{d.}{\mathrm{D}}}}{\mathrm{S}\,\tau\sqrt{2\,g\,\mathrm{H}}}$$

or, since the densities are inversely as their relative volumes,

$$\frac{l}{\mathrm{L}} = \frac{n\,\pi\,\mathrm{L}\sqrt{1 - \frac{\mathrm{V}}{r.}}}{\mathrm{S}\,\tau\sqrt{2\,g\,\mathrm{H}}} \qquad (6.)$$

As an example for low pressure steam, let $\mathrm{L} = 5$, $n = 25$, $s = 20$, $\mathrm{P} = 17{\cdot}78$ lbs., whence $\mathrm{V} = 1427$, $\mathrm{T} = 670$ and $\mathrm{H} = 58675{\cdot}7576$; let the temperature of the condenser be 110 degrees, in which case $\mathrm{V} = 14952$; and, if we suppose the piston to move through 200 feet in a minute, $\tau = 1{\cdot}5$ second. We have besides $\pi = 3{\cdot}1416$ and $g = 32{\cdot}19$.

Substituting these values in the second member of equation (6), we obtain

$$\frac{l}{\mathrm{L}} = \frac{3{\cdot}1416 \times 25 \times 5\sqrt{1 - \frac{1427}{14952}}}{1{\cdot}5 \times 20\sqrt{64{\cdot}38 \times 58675{\cdot}7576}} = {\cdot}0032.$$

In the example chosen the value of l would thus be less than one-fifth of an inch, and it will be remembered that this value is too great in consequence of our having substituted the ratio $\frac{\delta}{\mathrm{D}}$ for $\frac{p}{\mathrm{P}}$.

As an example for high pressure steam, we will take the data from locomotive engines, and assume $\mathrm{L} = 1{\cdot}5$, $n = 15$, $s = 20$, $\mathrm{P} = 77{\cdot}95$; whence $\mathrm{V} = 369{\cdot}5$, $\mathrm{T} = 760$, and $\mathrm{H} = 66557{\cdot}576$; also $v = 1700$; and, if we suppose the piston to move through 360 feet in a minute, $\tau = {\cdot}25$ second.

Substituting these values, we find

$$\frac{l}{\mathrm{L}} = \frac{3{\cdot}1416 \times 25 \times 1{\cdot}5\sqrt{1 - \frac{369{\cdot}5}{1700}}}{{\cdot}25 \times 20\sqrt{64{\cdot}38 \times 66557{\cdot}576}} = {\cdot}01007.$$

In this example, therefore, the value of l is but a trifle more than ·18 of an inch, or less than ¾ of the lead of ¼ of an inch usually allowed in locomotives.

The ratio $\frac{l}{\mathrm{L}}$ also expresses the proportion of the whole area of the steam port by which its aperture is diminished at the moment the piston reaches the middle of its stroke, and as this quantity is, as the wo above examples show, exceedingly small, it is unnecessary to make any allowance for it.

A FEW REMARKS ON THE CONSTRUCTION OF OBLIQUE ARCHES, AND ON SOME RECENT WORKS ON THAT SUBJECT.

UNTIL within the last few years, the construction of oblique bridges has been but little understood, from a doubt as to their stability, and from the difficulty of their construction, they were regarded to a certain degree with distrust, and the engineer would only have recourse to them when the circumstances of the case were imperative; the superior scientific acquirements of the engineers of the present day, however, the assistance of various books on the subject, and the great experience obtained in this species of construction, by the demand occasioned for them in the large railway undertakings which have lately occupied so much of the public attention, have contributed materially to remove the veil of mystery which formerly hung over them; the doubt which was at one time entertained of their stability is removed, the oblique bridge is now generally adopted, and the only point remaining to be cleared up is, as to the best method of working the parts together, so as to obtain the desideratum of engineering, viz., stability, economy, and beauty of appearance.

Since the commencement of the London and Birmingham Railway, four authors have written on the construction of oblique bridges, Mr. Fox, Mr. Hart, Mr. Buck, and Mr. Nicholson. It should be observed, with reference to the two latter, that Mr. Buck's work appeared before the third part of Mr. Nicholson's was published. The announcement of a work on this subject, by a person whose reputation as an author, stood so high as that of Peter Nicholson, naturally gave rise, in the practical world, to the hope that the difficulties which had heretofore attended the constructing of oblique bridges would, with his powerful assistance, be much reduced, if not entirely removed, but that our most reasonable anticipations are sometimes doomed to disappointment, was never more signally shown than in this instance. A few quotations will be sufficient to give a specimen of the errors and inconsistencies which, we regret to say, characterize this book. Mr. Nicholson says in his preface, "In this undertaking, the general reader is not supposed to be much acquainted with scientific researches," and he accordingly goes on, in the introduction, to inform him that a right angle contains ninety degrees, that 60 minutes make a degree, and that "a number having a small zero or cypher placed over the right hand shoulder of the figure or last figure, shows this number to be as many degrees as the figure or figures express." At page xx of the introduction, he says, "If a spiral surface be cut by a plane obliquely to the axis of the cylinder, the section will be a curve of contrary flexure, and if the spiral surface be cut by another plane passing along the axis, perpendicular to the first plane, the section, which is a straight line, will intersect the curve of contrary flexure at the point of retrogression." The first of these paragraphs appears intended for a person who has only learnt to read and write, while the second, it must be admitted, seems little adapted to the understanding of those who are unacquainted with scientific researches.

In Section IV, page xxiii, which treats of the trihedral, he states that "If a trihedral be cut by a plane perpendicular to one of its oblique edges, the section shall be a right angle." Now a trihedral may have all three of its edges oblique, or one obtuse and two oblique edges, or one right and two oblique edges, and the above assertion only holds good with regard to the latter; with such a glaring error as this among the definitions on which his trihedral system is founded, it is of course unnecessary to examine it further. One part of the subject in which Mr. Nicholson has been very unfortunate, is relative to the sections of spiral surfaces; of this we will only give one instance here, as we shall have occasion to return to this subject. He says, page 24, "the transverse section is, therefore, the only section of the spiral surface which is a straight line." Whereas, in introduction, page xix, we find, "If a spiral surface be cut by a plane, either perpendicular to or passing along the axis, the section will be a straight line.

The history and theory of oblique bridges is, by some system of arrangement peculiar to the author, placed after the problem for constructing the templets for working arch stones, and is followed by a practical method for obtaining the templets. This history, so curiously placed, appears to be introduced chiefly for the opportunity thereby afforded the author of making his own strictures on other works; but in his anxiety to detract from the merits of all authors but himself on this subject, he has again fallen into so many errors, as to leave no doubt of his being but superficially acquainted with the subject on which he writes.

Mr. Fox has asserted, in common with other writers on the oblique arch, that, "when the soffit is developed, the edge which formed the face of the arch gives a true spiral curve." Upon this Mr. N. remarks, "It must, however, be observed, that the edge of the develloped semi-ellipse is neither a spiral line nor the projection of a spiral line." In this remark Mr. Nicholson is decidedly wrong, for it is easy to demonstrate that the curve above mentioned is the projection of a true spiral, whose radius is equal to half the obliquity of the arch, and whose length is equal to the semicircumference of the cylinder on which the arch is assumed to be built. With reference to Mr. Fox having stated that the joints in the face are curves, Mr. N. says, "if they had been curves, the curvature would have been so small, that the joint lines would not have varied sensibly from straight lines. The true curvature of the joint could not, therefore, have been expressed in lines," Now if Mr. Nicholson had ever had occasion to put his rules into practice in a bridge of considerable obliquity, he would have found that the face joints near the springing are not only curves, but very perceptible ones. There is, moreover, nothing impossible in constructing the curves formed by the face joints, it is nearly as simple as the construction of the spiral itself; but this is a part of the subject on which Mr. Nicholson is throughout unfortunate.

Mr. Buck's Essay on the Oblique Bridge next falls under our author's scrutiny; that it should receive his entire disapproval, is not perhaps surprising. Mr. Buck has had the advantage of Mr. Nicholson in being able, while engaged on the London and Birmingham and other railways, to put his rules into practice, and prove them to be right before he laid them before the public; he has, for the same reason, been able to select the useful parts, and present them to the reader unencumbered by the superfluous and weary waste of words through which Mr. Nicholson's readers are doomed to wander. Relative to this work Mr. Nicholson proceeds to say, "The formula $co = (r+e) \cot \theta \tan B$ is due to Mr. Buck; it gives the distance below the centre to the point of convergence, into which all the joints in the elevation of the arch meet in the axis minor, supposing that the joints are straight lines, which they are not exactly." This having reference to the section of the spiral surface, no wonder Mr. Nicholson is again unfortunate. Mr. Buck does not wish his readers to turn the curves into straight lines, which peculiar operation, if properly conducted, is to cause the straight lines to converge to a point. He simply gives the point to which the chords of the said curves so converge, and the formula for finding this point is not all that is due to Mr. Buck, but the discovery of the fact that they do converge to a point, and the uses to which this discovery can be applied in facilitating the construction of the bridge.

Mr. Nicholson next complains that Mr. Buck has given, besides his general formula for finding the point of convergence, another formula which happens to be more convenient when making the necessary calculations for the segmental arch. He concludes at once that the results of these formulæ must differ, and puts forth his assertion to the world as if the book were in error. His concluding paragraph relative to Mr. Buck's book is, "One thing which we consider defective in Buck's Essay on Oblique Arches is, that his intentions are not enunciated under regular heads, so as to call the attention of the reader; he gives no reason for his rules, nor does he show the principles upon which his formulæ depend. The height of the point *o*, Fig 7, will depend upon the breadth of the beds."

The first part of this remark we will leave Mr. Nicholson to settle with his conscience in the best way he can. As regards the second part, we would ask what is the E in Mr. Buck's formula if it is not the breadth of the beds or the thickness of the arch, which is one and the same thing? Mr. Nicholson ought, in justice, to ascertain that an error really exists, before he implies that such is the case. That he has not long been acquainted with the fact of the chords of the joints in the face converging to a point below the axis of the cylinder, is evident from his book on stone cutting, in which the joints are drawn at right angles to the curve, and that he was unaware of the utility of knowing this point is equally evident, or he would never have given the laborious and complicated construction for finding the joints in the face, beginning at page 17.

Mr. Nicholson gives rules for what he terms two kinds of oblique bridges, namely, those in which the joints of the stones are planes, and those in which they are spiral surfaces; these rules are so jumbled up together, that the reader is at a loss to know to which of the two species of bridges they refer. At page 15 there is a problem, "To find the curved bevels for cutting the quoin heads of an oblique arch." The reader being unable to learn from the heading of the problem whether it relates to square or spiral joints, naturally proceeds to wade through it, with the hope that it may afford some means of ascertaining this fact, but here he soon becomes lost in a labyrinth. You are told to divide the arc A B C into as many equal parts as the ring stones are in number, and through the points of division draw *b k*, *c i*, *d j*, &c., perpendicular, to the curve A D E. A B C and A D E being two different curves in two different directions, there is evidently a great omission somewhere, which, however, we might forgive if his meaning could be discovered, but it cannot. A little further on he tells you to join *a m*, *b m*, *c m*, &c., but where the point *m* is to be placed, Mr. Nicholson has quite forgotten to say.

Page 10, referring, as is stated at the head of the page, to plate 24, is another example in which, from the type being completely at variance with the plate, we are left quite in the dark as to what the author wishes to communicate.

The practical part of this work, if, indeed, any part may be so called, is scarcely less defective than that of which we have already spoken; the direction for dividing the face of the arch into stones of unequal thickness is unworkmanlike and unsightly, and where brickwork is used, the joints must necessarily be larger on one side than on the other.

On the whole it must be admitted that the book is far from being worthy of the great reputation Mr. Nicholson has hitherto justly acquired; it has the appearance of being got up by his journeymen, and signed with his name without a sufficiently careful revision. But we have said enough, though, in closing the book, we cannot but express a wish that, before he had sought the mote in his brother's eye, he had removed the beam from his own.

Manchester. W. H. B.
March 26, 1840.

MARINE ENGINES.

Employment of the expansive principle to its full extent in Marine Engines, with a saving of half the fuel.

Sir—In my remarks in your Journal of last month I dwelt at some length on the advantages to be derived from the employment of the Cornish double beat valve in marine engines, especially the facility which such afford of working the steam expansively. But it may be asked why all this talk of working expansively where there is little or nothing to expand? I would answer this question by another: why adopt a good plan by halves? take the Cornish boilers also, or a suitable modification of them, and raising the steam to 35 lbs. effective, carry out the principle of expansion to its full extent; this would at once reduce the consumption of coal one half, and so double the range of our steam navigation. On such a startling proposition as this being mooted, the question naturally suggests itself, how has this so long escaped the first men of the day? That I shall not attempt to answer; it is sufficient that it has escaped them, and a very slight examination of the matter will make this evident.

Thus taking the horse power at 33,000 lbs. lifted one foot per minute with a consumption of 8 lb. of coal per hour, and this is below the average consumption, we get a duty of 23,000,000 (though 20,000,000 would be nearer the mark, especially in steam boats).

If any be disposed to assert that this is overstated as regards the Great Western and British Queen, as these vessels are said not to consume above six or seven pounds per horse power per hour, I answer, the Queen's engines are 500 horse power at 15 strokes per minute, or the piston travelling through 220 feet per minute, now the pressure of steam, &c. remaining the same, the power exerted by the engine is exactly as the space through which the piston travels; but 12 strokes per minute is nearly the average number the engines make, as appears by her log; this reduces her power in the ratio of 15 to 12, and increasing the consumption of fuel per horse power in an equal ratio, makes the six or seven pounds nominally consumed equal to 8 or 9.

Whereas many of the Cornish double acting crank engines used for stamping ores, the most trying work an engine can possibly be subjected to, and where there is greatest loss by friction, are doing a *duty* of 50, 56, and even 60,000,000, as appears from the authenticated reports of the engineers.

Although this will not be doubted by any one who has had the opportunity of seeing the engines at work, it may suit some to doubt and even to deny the truth of these reports; so they did those of the pumping engines doing a 70 or 80,000,000 *duty*; but as 90, and even 100,000,000 is now being done under their eyes, what credence can such men expect for any statement they may in future make.

Having had occasion to visit Cornwall some three years ago on business, immediately after having completed the engines of a large vessel now on the London and Dublin station, the easy valves, the cool engine room, and almost smouldering fires of the Cornish engines, as contrasted with the stiff and heavy slides, the suffocating heat of the engine room, and roaring furnaces I had just left, attracted my particular attention; and though possessing at that time no data beyond the published reports of the engineers, I saw enough to convince me of their immense superiority, and at once set about considering how the same plan could be carried out in marine engines, a point which I hope to be now able to make clear, and the objections to which I shall endeavour to deal with in detail.

The first is the increased danger of explosion or collapse supposed to be occasioned by the great density of steam.

The second is the additional strength required in the engines to withstand steam of such density when first admitted into the cylinders.

The third is the increased weight of the boilers, and the extent of flue surface required for their successful application.

The first objection, the increased danger, I shall begin by denying "in toto," nay, it appears to me that there is absolutely increased safety, for the following reasons:

Setting aside the increased weight, &c., one boiler can be made quite as capable of supporting a pressure of 35 lbs. as another is of supporting 3 lbs.; the safety valves would have much less tendency to stick fast under the higher pressure, and their becoming a little stiff, or two or three pounds overloaded, would not be of the slightest consequence on a boiler calculated for a pressure of 35 lbs., though it would have a very dangerous tendency on one calculated for 3 lbs.

But the great argument for increased safety is this: it is an established fact that with boilers of the usual construction, nine-tenths of the steam boat accidents occurs through collapse of the overheated flues, much more than from any excessive pressure of steam in the boiler; nor is this to be wondered at if we consider how the fires are urged. Now with the Cornish boilers and a proper system of expansion, the same work can be done with half the coal, and if we consume only half the coal on the same or a greater extent of fire bar and flue surface in a given time, then it follows clearly that we have a fire of only one-half the intensity, and the risk of collapse from overheated flues diminished in like proportion. But if these arguments are insufficient, then the following fact is greatly in their favour, viz., that as few if not fewer accidents occur in Cornwall where such boilers are in universal use, than in any part of the kingdom where steam power to a like extent is used; and if it be further true, as I have heard stated both in Cornwall and elsewhere, that many of the Cornish engineers will engage to keep up the boilers for ever, for the annual sum of 5 or 6 per cent on their original cost,* such an argument appears to me, as it will to most practical men, to be at once perfect and conclusive.

I now come to the increased strength required in the engines, and this on examination will appear trifling. To commence then with the paddle-wheels as they remain of the same size, and are driven at the same speed, no alteration is required in them, and of course the same remark will apply to the paddle-shafts through which the power is transmitted. These being subjected to no increased strain as the average effective pressure upon the piston which takes place when the piston is half stroke, &c., and the crank at its point of greatest torsion, is the same as in a common engine. The intermediate shaft alone with its cranks, in which the crank pins are *fast*, requires additional strength, and as this shaft is only about one-sixth the length of the two paddle shafts, and the strength of a shaft increases as the cube of its diameter, the increased weight will be trifling: next there is the top frame that carries this shaft, and the bottom frame supporting the gudgeons and columns, the strength of both must be increased, and it is as the square of their depth; next comes the piston rod, this will do as before, the piston rod of a large engine being equal to 20 times the strain it is ever subjected to: the same remark will apply to the malleable iron columns supporting the top frame, as each of them is usually made of the same strength as the piston rod.

The piston must be strengthened, but the cylinder will do as before, as it is strengthened at the extremes where the greatest pressure of the steam is by its flanges, and in ordinary cases we are under the necessity of making it much stronger then necessary to ensure a sound casting, and also to support the framing attached to it; besides a cylinder of three-fourths the capacity is sufficient for the same power, so here we are positive gainers in two most important points, strength and space. The gudgeons of the cylinder of double the strength will not be stronger nor heavier than the main centres of the beam engine of the ordinary construction must necessarily be.

The points then which require increased strength are, the intermediate shaft and gudgeons, the top and bottom supporting frames, and the piston. The increased weight from this cause would not exceed 6 or 8 per cent. beyond that of the same description of engine at the ordinary pressure, and after taking this into account, the total decrease, by adopting the vibrating cylinder, would be at least 25 per cent.

I now come to the question of increased weight in the boilers, and this I shall be able to show is not nearly so great as may at first be supposed.

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* Perhaps some of your readers can affirm or contradict this.

It will scarcely be disputed that the same thickness of plate in cylinders 6 feet diameter, the size of the exterior cylinder of the Cornish boiler, will bear a water pressure at least 3 times greater than if arranged in the usual form of a steam boat boiler; or that the former of 5-16th thickness would bear without flinching a proof pressure of 60 or 70 lbs. to the square inch, while the latter would give evident signs of weakness at 20, although ever so well stayed. If then it be considered perfectly safe to work steam of 6 or 7 lbs. pressure in a boiler which would give evident signs of weakness under a pressure of 20 lbs., surely it is equally safe to work steam of 30 or 35 lbs. in a cylinder of 6 feet diameter, and ½ inch thick, which would bear without the slightest signs of weakness 120 lbs. on the square inch, boilers of this size and thickness being usually worked to 40, 45, and even 50 lbs. per square inch. Then 4 feet diameter, and 7-16ths thickness will be ample for the internal cylinder, and to make security doubly secure, let a strong angle iron be rivetted round the internal cylinder at distances of about 2 feet apart, this would keep the cylinder or arch perfect, and so prevent the possibility of a collapse, with but trifling addition to the weight of the boilers.

Now taking equal extent of common and Cornish boilers, the former taking all stays, &c. into account, will barely average 3-8ths in thickness, while the latter with its internal tube of 18 inch diameter, and 5-16ths thickness, would average about ½ inch. This makes their respective weights at 3 to 4, but in order to the successful application of slow combustion we require addition flue surface, so take 3 to 5 as the ratio of the weight of common and Cornish engines and water for the same power, the extra space required for the boilers being much more than compensated, by the small space occupied by the vibrating engine.

But to go more minutely into the matter, the weight of a Cornish boiler and water of the size and thickness named, and 35 feet in length, is = 24 tons, exposing a surface 938 feet: eight such boilers might be easily set in the space allowed for the Queen's boilers, now $8 \times 24 = 192$ tons, as the weight of the boilers, and allowing 50 tons for setting and clothing, we have $192 + 50 = 242$ tons, total weight of the boilers and setting, &c.; $938 \times 8 = 7504 \div 500 = 15$ feet surface per horse power being one-half more than theusual allowance without increasing the weight of the boiler at all, or occupying more space in the vessel.

But allowing that we have increased the weight of the boilers in the ratio of 3·5, let us take the British Queen as the subject of comparison.

The total weight of her engines and boilers is 500 tons, and of this 220 may go in round numbers for boilers and water, and $3 : 5 :: 220 : 366$, and $500 - 220 + 366$ gives 664—and less 64 tons being the decreased weight of the vibrating engine = 600 tons, as the weight of her engines and water on the Cornish plan.

The account would then stand thus, on the present plan,

Engines and boilers - - - - -	500 tons
20 days fuel - - - - - -	750
Total - -	1250

On the Cornish plan,

Engines and boilers - - - - -	600
20 days fuel - - - - - - -	375
Total - -	975

Showing a capacity for 285 tons more cargo, and a saving of 375 tons of coal.

Though some may consider these figures as exaggerated without being able to assign any reason to themselves or others, save that the plan is impossible. Those who have examined the subject will assuredly blame me for not having gone far enough; and there is another class of well meaning men among engineers and others, who have imbibed such a reverence for the name of Watt, that they almost consider any deviation from the plans he followed, or improvements upon the state in which he left the steam engine, to be an insult to his memory, and a deduction from his fair fame; but my admiration of Watt is as great as any man's can be; I am proud of him as a countryman, and honour him as a great man, and so have endeavoured to add a stone to the monument he has raised, by carrying out a principle which in his third patent of 1782, he distinctly propounded, and of the advantage of which that great man seems to have been fully aware, though he lived not to see it carried into effect.

If then I am born out in these statements, and to disprove the main point, the great increase of duty by expansive working is altogether impossible; and the others I think I have succeeded in making tolerably clear, though on some points as the weight of the present boilers and water of the British Queen, I may have made some slight mistake, not amounting to a few tons either way, having assumed it from comparison with others, and not stated it from actual knowledge, yet on the other hand I have underrated the saving of fuel, and allowed quite enough for the increased weight of the boilers, as there is less due to the great extent of surface than is supposed, the expansion being the point where the power is gained; and however the proposition of adopting steam of increased density may be cavilled at, to the principle of expansive working and slow combustion we must come at last, and by adopting them to their full extent, which I think I have shown to be equally safe and perfectly practical. The Cape of Good Hope is as much within our reach as New York now is, and a speedy and sure passage open to our Indian and Australian empires.

Such then being the case, are we content to allow our preconceived ideas to supersede our better judgment, and go on loading our vessels with unnecessary coal, and thus uselessly consuming our most valuable mineral—limit at the same time the range of our steam navigation, and the civilization of the world at large; or do our engineers mean to allow that they cannot make a boiler safe under a pressure of 35 lb., or that one of the thickness and diameter that I have proposed would not be perfectly safe under that pressure. If they allow neither of these propositions, then the sooner the subject is seriously taken up the better, as every boat now fitting with the usual beam or side lever engines, (and many of the splendid mail packets are being thus fitted), is incapable of being afterwards altered, so as to work expansively, as though the boilers may be altered, the beams, &c. would never stand the increased pressure.

Before concluding, perhaps I may be allowed to correct an omission in my last paper. It is a favourite remark of naval men, "get as extended a hold of the vessel as possible." Now it has often struck me, not only in those vessels I have myself been engaged in, but in every one I have had the opportunity of seeing, that this very reasonable remark is not only not complied with, but that the power is positively brought to bear on the wrong place. Thus no attempt that I have seen has been made to lay hold of the vessel fore and aft in a line with the centre of the paddle shaft, but the framing is stayed sideways, or at best slightly supported by the most contiguous deck beams, and the horizontal strain of the propelling power acting at the bearings of the shaft, the engine frame is thus used as a lever to wrench the under frame of the vessel as it were asunder, and an action is thus created tending materially to weaken the vessel and increase the unpleasant vibration, to remedy this defect, and at the same time to prevent the framing and joints of the engine from breaking, uncommonly heavy bed plates have been resorted to; those on board the British Queen amounting at least to 23 tons; now without entering into a discussion on the point, what I propose is this, let a strong flat bar of wrought iron be carried fore and aft opposite each engine, gradually tapering away, and running in towards either side of the vessel, being at the same time securely bolted through ten or twelve of the deck beams, on the end of this next the engine, let there be a strong joint and a similar one on the engine frame joined by a strong connecting rod, this would allow sufficient play, and at the same time, if I may use the expression, give the porter a hold of his load by the right place.

To conclude, if it be considered that I have not gone sufficiently into detail completely to prove every point I have advanced, my answer is, I have considerably underrated the gain, and overrated the loss, thus rendering minute calculation of strength and weight uncalled for; besides such would have been of no value to any one not intimately acquainted with the subject, and practical men can examine it for themselves.

My object has been to keep the main points of the argument in view, and to make it intelligible to all classes of your readers, and in this I hope I have succeeded, and should you or any of your readers be able to furnish me with the exact weight of the boilers[*] of the British Queen, and the space they occupy, with any further particulars, I will in a future number enter more minutely into the subject, and illustrate by a few sketches my ideas of how the boilers on the Cornish plan should be set and clothed, and where the extent of surface I have spoken of is obtained; having no doubt that I shall be able to establish every point that I have advanced, bearing on the increased safety and economy of the plan proposed, and at no distant period see it carried into successful operation on a scale commensurate with the importance of the undertaking, and the vital influence which such an improvement would have on our political and commercial relation with all parts of the world.

Pimlico, April 4, 1840. A. S.

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[*] The modification of Cornish boilers I propose to adopt has no *external* flues.

RAMBLES BY PHILOMUSÆUS.—No. 6.

THE SOANEAN MUSEUM.

The Soanean Museum is again open for the few months and days which its managers think necessary to afford the public. Three months in the year, and two days per week, are in these days thought enough—we wonder the trustees do not think of charging a shilling, it would be carrying out the *rococo* style completely. Why not take immediate steps for throwing it open? Take up the carpets, apply to the legislature for funds to enlarge the establishment, make the museum worthy of the nation, and the trustees will do honour to themselves and to the memory of the founder. They have, in Mr. Bailey, a talented and well-intentioned curator, with one only fault, that he is disposed to regard an establishment worthy of the public, as only to be conducted for the use of artists,

> "Who, born for the universe, narrowed his mind,
> And to party gave up what was meant for mankind."

Let Mr. Bailey, if he places any value upon the promotion of public instruction, urge the trustees to do their duty.

This year a catalogue has been produced, which, as a first attempt, is of course rather scanty in size, but we are bound to say that the matter which is given is highly creditable to the exertions of the curator. It beats the National Gallery affair hollow, and is superior to the antiquarian portion of the British Museum catalogue. Why is there not a catalogue at the East India Museum? We have only one objection, and that is to the price; we think that three pence would have been rather nearer the value than a shilling; it does much honour to Mr. Bailey; however, there are copies left on the tables for the public to consult, besides the more extensive catalogue *raisonné* of Sir John Soane, so that the officers are acquitted of the slightest intention of jobbing or keeping back information, although they may have erred in a matter of judgment. Indeed, the wish to give information, and the courtesy with which it is imparted, seem, from the example of the superiors, to inspire the lowest officers of the museum, and it were to be wished that, in other establishments, the same spirit prevailed among the attendants.

The list of trustees given in the catalogue is far from inspiring confidence in any one who knows anything of them; there is only one man, indeed, who can be regarded as an active friend to public improvement, for as to the others, they are many of them notorious sticklers for acknowledged abuses. The sooner the museum is put under more active and responsible management the better. While the present parties doze over their duties, the place will continue to be a knicknackery instead of a national institution, and Sir John Soane's weeds will be allowed to usurp the place of his laurels. What we require is a proper classification, sufficient space, and facility of access for students and the public.

Sir John Soane has left the place, like his own head, with all kinds of queer corners in it; but irrespective of his arrangements, we shall proceed to notice, under their several heads, some of the principal objects.

The picture gallery, by means of *moveable planes*, has, crammed into the small space of 13 ft. 8 in. in length, 12 ft. 4 in. in breadth, and 19 ft. 6 in. in heigth, as many works, according to the book, as would cover a gallery of the same height, 45 ft. long and 20 feet broad. Besides the works in these rooms, are others dispersed through the Museum, so that in all there are about fifty paintings and forty drawings, besides statues and bas reliefs in numbers. These works ought to be removed from the museum or sufficient accommodation provided for them, as they are much too valuable to be sacrificed in the present holes and corners. The collection of the English school is very fine, containing 37 paintings and 25 drawings by our first artists. Among these are 12 Hogarths, which cost nearly 2,500*l*. the Rake's Progress and the Election; the Snake in the Grass by Sir Joshua Reynolds; a Jackson, 4 Howards besides the Ceilings, a Danby, a Bourgeois, a Fuessli, a Bird, a Ward, a Durno, an Eastlake, 3 of Jones, a Hilton, a Flaxman, 3 Stothards, 3 Corboulds, 2 Calcotts, 2 Daniels, 2 Turners. Of foreign masters there are specimens by Raffaelle, 4 by Canaletti (and the *chef d'œuvre* from Fonthill), by Rubens, Paul Veronese, Watteau, Ruysdael (3), Ostade and Zuccherelli.

The collection of sculpture, marbles, casts and models both ancient and modern, is fine. The specimens of Flaxman's works are above 40 in number, and ought to be brought forward so as to form a collection of the works of this great artist, who has done so much for our progress at home, and our architectural reputation abroad. Among them are figures and bas-reliefs of Piety, Charity, Truth, Winged Victory, Tenderness, Resignation, Hope, The Adoration, Joseph's Dream, Adam and Eve, Michael and Satan, a Grecian Feast, the Shield of Achilles, Mercury and Pandora, the Golden and Silver Ages, Cupid, Psyche, Britannia, Marquis of Hastings, Warren Hastings, Lord Mansfield, Pitt, Michael Angelo, Raffaelle, Reynolds, Kemble, &c. The works of Banks are about ten; they include the sleeping girl, St. Peter in Prison, the Dying Patriot, Achilles, and Caractacus. There are also specimens by Michael Angelo, John de Bologna, Donatello, Rysbrack, Westmacott, Chantrey, Gibson, Baily, Rossi, &c.

The architectural department includes drawings, models of buildings, and of details, and wants only arrangement to form a collection in the highest degree valuable. Among the drawings are all those of Sir John Soane's works, and others by Piranesi, Zucchi, Bibiena, Campanella, Clerisseau, Pannini, Labello, Asprucci, Sir James Thornhill, Sir W. Chambers, Kent, Sir Robert Smirke, &c. There are busts of the following architects: Palladio, Inigo Jones, Sir C. Wren, Sir W. Chambers, Dance, and Sir J. Soane.

The antiquities and curiosities might be made to form a museum as useful to artists as the new rooms in the Louvre at Paris, to which the artist and the pattern-drawer might resort with the greatest advantage. The purchase of the Belzoni vase was a terrible satire on the mode in which our museums are conducted, and a worthy pendant of the Ægina marbles affair; Sir John Soane said that he was but too glad to give the two thousand pounds the British Museum refused. Among the miscellaneous objects may be mentioned, Sir Robert Walpole's tables, Napoleon's sword and portrait, the Napoleon medals, Peter the Great's pistol, Tippoo Saib's chairs, Queen Mary's table, &c.

CANDIDUS'S NOTE-BOOK.

FASCICULUS XV.

> "I must have liberty
> Withal, as large a charter as the winds,
> To blow on whom I please."

I. The clever and pleasant writer, "Nimrod in France," (Colburn's New Monthly), says in regard to French Houses, "There is one essential in the construction of them, of which I cannot speak too highly, and that is their mortar. It appears almost to equal in hardness the similar preparation of lime and sand mixed with water, for which the Romans were so celebrated, and which for its powers of cement and its durability, we have not been able to equal by our system of admixture. Certainly the French mortar may justly be called *cement;* and it is well that it can boast of this superiority, inasmuch as French bricks are most inferior to ours, from want of skill and care in the burning of them. French houses, however, generally speaking, are miserably defective in their plans, both for convenience and comfort, nor does there appear to be a desire to improve their structure. A heavy tax on windows and doors would be a blessing on the country—at all events as far as it would relate to lumbago, rheumatism, catarrh, coughs, and sundry other pains and penalties which human flesh is heir to."

Perhaps, too, a heavy tax upon supernumerary windows would be a benefit in this country,—at any rate it would be so architecturally, since scarcely anything is more inimical to nobleness of aspect, to solidity of appearance, and to repose, or more productive of insignificance than windows crowded together in such a manner that the piers between them are not so wide as the apertures themselves. This is an exceedingly common fault, the ordinary practice in London house-building being to put three windows where two would be sufficient. The consequence is that one side of a room is nearly all window, with no space for other furniture than chairs or mere knick-knack tables; so exposed to the sun in summer time, that it is necessary to exclude it by blinds, and occasioning a cheerless uncomfortable look in cold and bad weather. While as additional agremens, may be mentioned, that unless the street be a very wide one, your front rooms are thus fully exposed to the full fire of your neighbour's eyes, of "the amiable people over the way" who most disinterestedly interest themselves in reconnoitring your *menage* as far as they can penetrate into it; and who, of course, busy themselves in imagining what they do not see.

II. 'Marry in haste and repent at leisure,' is a proverb that mutatis mutandis applies to architecture,—both to architects themselves, and their employers, many designs being adopted without due examination, the consequence of which is that their faults and defects escape notice, until it is either too late or too expensive to correct them. Nay in some cases the faults are so exceedingly glaring that it is wonderful how the designs could pass muster at all,—or how any one, calling himself architect, could make up his mind to pass off upon his employers the barbarously crude ideas we so frequently behold. Happy is it for such people that their employers are not only ignoramusses, but most tasteless ignoramusses into the bargain.—And that tribe among professionalists are therefore quite right in exclaiming against amateurs and amateurship, since the more the public become enlightened, the worse must it fare with them. They ought to pray for blockheadly gullible patrons—persons who look upon architecture as an unfathomable mystery, which the initiated alone have any right to understand.

III. Where ignorance is bliss—but I need not repeat the rest of that very hackneyed quotation,—therefore observe that I have sometimes almost envied the blessedness of ignorance, as I lately did while walking with a friend from the country, in the Regent's Park, whose rows of paltry mock palaces called forth expressions of admiration from him, that, I presume, were perfectly sincere. To the shade of that miserable architectural sinner John Nash, they must have been a requiem, but to me, to have to listen to the praises of that consummation of paltriness, was hardly endurable. And yet my companion was a person of tolerably good taste in other respects, and what is generally understood by "a well educated person," though imposed upon by such arrant architectural balderdash as those same terraces are. It seems to me that most persons have not the slightest shame whatever in displaying the grossest stupidity relative to every thing connected with architecture; and why is it so, except because the notion has been instilled into them—would that it were flogged out of them!—that it is for architects, and them alone, to pretend to understand its principles, these latter being, by some curious jumble of ideas, supposed to be entirely *mechanical*, notwithstanding that architecture itself has got the name of one of the fine arts. I once fell in with a gentleman, who was hardly less than a Solomon in his own conceit and pretensions, and who nevertheless staggered me by the *candour* with which he confessed he never could comprehend the ground plan or section of a building, or understand what they meant! Notwithstanding which degree of gentlemanly or genteel and blissful ignorance of low mechanical matters, my Solomon could, I found, speak glibly and boldly enough 'by look,' passing his opinion upon buildings, of which it was very evident, although he did not care to make such confession, that he understood no more than he did of sections and ground plans. There are, I am afraid, too many Solomons of his kind among our enlightened public."

IV. In an article entitled "The British School of Architecture," Blackwood's Magazine, August 1836, it said that the fourteen columns of the intended Doric structure on the Calton Hill, are "even now the most imposing objects of the kind in Britain: they impress strangers more than any modern edifice in the island, and if the structure be completed by the munificence of donations or bequests, on the same scale of primœval magnificence, it will give to the Scottish metropolis a distinction beyond what any capital in Europe can boast." The scheme for that national monument is also warmly advocated in the New Edinburgh Review, April, 1823. It seems, however, that the Scotch are too poor to prosecute the undertaking any further, else no doubt their prudence would urge them to complete as speedily as possible a building that could hardly fail to attract a great many visitors to their capital. Nevertheless some of them have so much money that they make the most desperate efforts in order to get rid of it, for instance, that remarkably silly Lord, Lord Eglintoun, who had he given towards this work the thousands he expended upon his tomfoolery of a tournament, would have secured to himself a very different reputation from what he has now got. Nay even the good people of Edinburgh themselves would act more wisely were they to complete the building on the Calton Hill, before they think of such matters as the Monument to Sir Walter Scott, unless indeed they are of opinion that, notwithstanding his hundred volumes, he is likely to be forgotton by the next generation.—Not the least singular circumstance of all is that beyond its name being mentioned, there is no notice of the 'National Monument,' on the Calton Hill, in John Britton's 'Modern Athens,'—a very remarkable work by the by, if only on account of its exceedingly funny dedication to "My Dear Sir Walter."

V. 'What is your opinion,' said a friend to me, 'of Italian Architecture?'—When I know what you mean, was my reply, I can perhaps answer you, but you might just as well ask me what is my opinion of English literature, without particularizing any further, and I should tell you, perhaps that at the present day a great deal of it is most arrant slipslop, and another great deal confoundedly villainous—to wit the Newgate school of it. So too, in Italian architecture there is a vast deal of most horrible rubbish, and also much that is admirable and delightful. Between such men as Francesco di Giorgio, Sanmicheli, Balvassore, Peruzi, and Borromini, with a long et cæteri, the difference is incalculable,—as great as between Charles Barry and *Mister* Nash.—As for Palladio I freely abandon him to his admirers.

VI. Never need the country be put to expense for a monument to George IV., because, as long as it stands, Buckingham will prove a monument of his—dotage. And surely his taste—if he ever had any must have been quite in its dotage when he approved of Nash's designs for that unfortunate building. 'Tis a thousand pities that two old gentlemen should have laid their heads together to palm such a piece of architecture on the country. In one particular, indeed, it may be said to resemble Perrault's façade of the Louvre, inasmuch as it has coupled columns—*hoc Ciceronis habet*: but then even in that respect, it is egregiously more faulty, columns in pairs being introduced into a prostyle portico, whereas in the other edifice they form lengthened colonnades. On the other hand, although the mode of columniation adopted for the centre portico is rendered more glaringly offensive, by there being only single columns in those at the ends of the wings. After all, defects of this kind shrink to nothing when compared with the insignificance, and the pettiness of manner which characterise the whole building.

VII. The York Column is a prodigiously blank affair altogether,—one excuse for which may be that it would have been a puzzling, and somewhat ticklish affair to introduce any kind of sculpture, because the most appropriate and characteristic symbols would have been a gaming-table and dice-boxes, in allusion to the exploits, the heroism, and the martyrdom of the Royal Duke. Yet if as a piece of architecture that pillar is any thing but admirable, it may be turned to admirable account as a warning, and it is devoutly to be hoped that nothing similar will now be perpetrated in Trafalgar Square; especially as there is no occasion whatever to make the buildings around it appear at all lower, or more insignificant than they now do; which would infallibly be the case should a "huge bully" of a column be erected in the centre of them.—According to the newspapers, however, it would now seem that the Nelson Column is to be begun forthwith, on the strength of subscriptions coming in, which may *perhaps* provide a statue for the top of it; if not, *tant mieux*, for then it must at all events prove a *capital* affair.—Or commemorating Nelson so flagrantly would it not be just as well to commemorate him *fragrantly* after the manner in which Delcroix has just *commemorated* a recent event by his 'Bouquet de *Noces* Royales,'—which it should be observed does not exactly mean Royal Noses, although intended to tickle the noses of gentility. —I am afraid that Delcroix is a sad wag.

VIII. According to a recent German writer who professes to enlighten his countrymen as to our national character, English people, especially those of *ton*, are exceedingly shy of Munich, whose noble buildings and treasures of art possess far less attraction for them than do the coteries and gaming-tables of such places as Baden-Badin. There is, it is to be feared a great deal of truth in this; yet hardly is it to be wondered at, if the same satirical writer be correct in the classified catalogue he gives of the kind of English who visit the Continent, for he states that out of every thousand, 333 are half-pay officers, 100 ruined gamblers, 20 cast off kept mistresses, (who affect to pass for patterns of virtue,) 48 'Greeks' on the look out for 'Pigeons,' 50 economists—political ones of course,—who adopt the prudent economy of getting beyond the reach of their creditors, 10 people of wealth and rank, who, by way of change, *ennui* themselves abroad pretty much after the same fashion they do at home;—to cut this formidable list short,—just one Englishman in a thousand, who visits the continent in order to gain information and improve his taste. Assuredly the picture is not a very flattering one,—doubtless much exaggerated, but correct or not says a very great deal, because it shows in what light we are looked upon by foreigners. The same writer sets us down as absolute barbarians in music, which he says, we only hypocritically affect to admire without the slightest feeling whatever for it; and if he does not censure our taste in architecture, it is in all probability because he does not touch upon that subject at all; else, I conceive, many of our moderns would have excited his bile, not a little. However, be our taste in architecture what it may, we cannot be accused of much hypocrisy or affectation there; for the public generally do not care even to pretend to know any thing whatever about architecture. —Where our buildings have been spoken of by Germans, it has seldom been in terms of commendation; and it would not perhaps be amiss, if some of our architects were to read a few of their comments, and make themselves acquainted with their opinions, for though they could hardly fail of being an exceedingly unpalateable, they might also prove a very salutary dose to them.

IX. It is astonishing what downright silliness and nonsense is frequently made to pass for argument. A notable instance of the kind occurs in the article Architecture in the celebrated Encyclopédie Methodique, where it is said "La colonne doit être ronde, parceque la Nature ne fait rien de quarré." The same mode of reasoning might be employed to convince us that the surface of walls ought to be rugged, and floors uneven, *because* nature does not make the face of rocks perfectly smooth, nor the ground perfectly solid and level;—or again that besides being round, columns ought to have a rough surface, resembling the bark of trees,—for we suppose it is to the stems of trees we must look for the prototype of the shaft of columns. Besides, if columns are to be made round *because* nature makes nothing square, would not that be an excellent reason for making the architrave round or cylindrical also, merely cutting away so much of the under surface at intervals as would be requisite for its resting firmly on the flat abaci of the capitals. This might be done; and according to such theory, it would be both correct and natural,—perfectly in consonance with the BECAUSE assigned. Nay, might we not say that the convex or pulvinated frieze frequently given by Italian architects to the Ionic entablature is formed upon strictly rational principles, namely, agreeably to the aforesaid BECAUSE. But then if columns are round, because, &c.—how happens it that the abaci of their capitals are square?—or are we to suppose that while Nature herself shapes the columns, she leaves her apprentices and journeymen to make the capitals, &c. as well as they can. The sober truth is, all such reasoning is mere rigmarole, and if no more rational and likely *because* can be found out, as I apprehend could be, it is not worth while attempting to offer any at all.

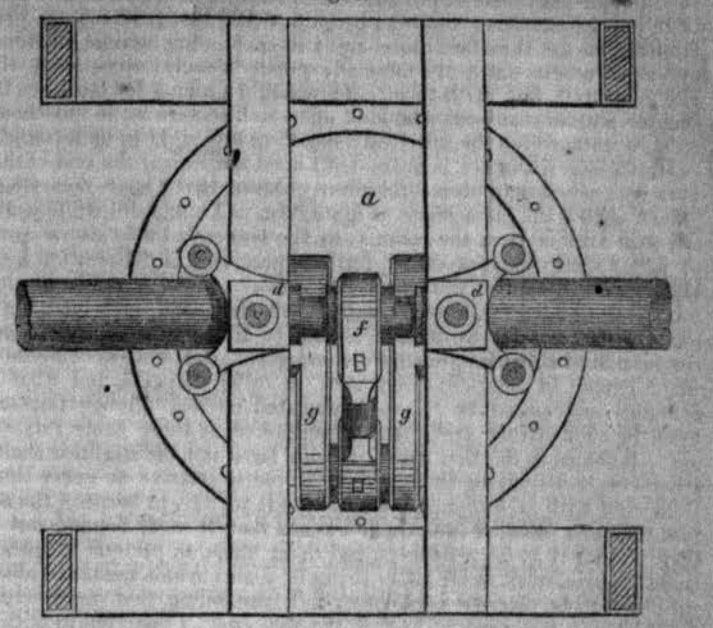
X. The real BECAUSE wherefore we make our columns round, is no other than because others have invariably done so before us; for which, again, there may have been more than one reason, and among the rest that of convenience, a circular shaft or pillar occupying less space than a square one of the same diameter, since the latter exceeds the former by the difference between the measure of its diagonals and its sides. Besides which, round pillars offer a greater contrast to walls and other flat surfaces, consequently tend to produce variety, while, at the same time, such form recommends itself as being, in some degree, more consonant to the prototype furnished by nature in the stems of vegetables and trees; and more studied and artificial also—more *recherché* than the other. Yet, although example and habit alone, independently of other considerations, cause us to regard the circular form as the most suitable, as well as the most beautiful, one for columns, it does not exactly follow that square ones are absurd—contrary to both beauty and reason, and that they ought never to be admitted at all. It is true no authority for insulated pillars of such shape, is to be met with in Grecian architecture; but then, neither does it supplyus with precedents for antæ or pilasters continued along the front of a building, and many other things which are nevertheless practised without scruple, even where Greek architecture is professed to be closely followed. I do not pretend to say that square columns are so well adapted as others for general purposes, but there certainly are cases in which they might be introduced both with propriety and effect, either by themselves or in combination with circular ones, and either way would produce greater variety of design than can be obtained by restricting ourselves on every occasion to the use of round columns. Hardly will it be expected that I can explain myself more fully without sketches and cuts; yet I can mention one instance where I conceive a good effect might thus be produced, which is supposing it necessary or desirable to have two insulated orders, one above the other, forming, for example, a lower and upper portico, that below might have square pillars—not mere piers—of about the same diameter as the columns over them; whereby, not only would a monotonous repetition be avoided, but greater solidity would be obtained in the basement order.

XI. Would it be believed that a professed architectural writer, no other, in fact, than M. Quatremere de Quincy, speaks of "Vasbrug *ou* Væsbrug," under which queer metamorphosis he gives his readers the name of the architect of Blenheim. If it arises out of sheer ignorance, of the inability even to copy a word correctly when in print, what reliance is to be placed upon his accuracy. On the other hand, if it is merely the affectation of ignorance, it amounts to downright puppyism. The most ignorant Englishman would not say Boiler, or Vaultair (instead of Boileau and Voltaire;) at least, no English biographer would so designate those writers. But the truth is, that, in literary blunders, one Frenchman is at any time a match for two Irishmen. Among ludicrous instances we may find, "Hirzel an Gleim über Sulzer," translated "Hirzel sur le Gleim," with a note explaining that "Gleim est une petite rivière de l'Allemagne." ! Poor Gleim! his poems must have been watery compositions indeed. Another Frenchman confounded Pressburg with St. Petersburg; and we now find Vanbrugh converted into Vasbrug or Væsbrug, which double mistake plainly proves it not to be an error of the press.

Rennie's Trapezium Paddle-wheel.—We understand Mr. Rennie has fitted the Lily, one of the boats plying between London Bridge and Hungerford Market, with his patent trapezium paddle, and that her speed is improved, as well as having done away with the swell caused by the ordinary paddle.

MAUDSLAY'S AND FIELD'S STEAM ENGINE.

Fig. 1.

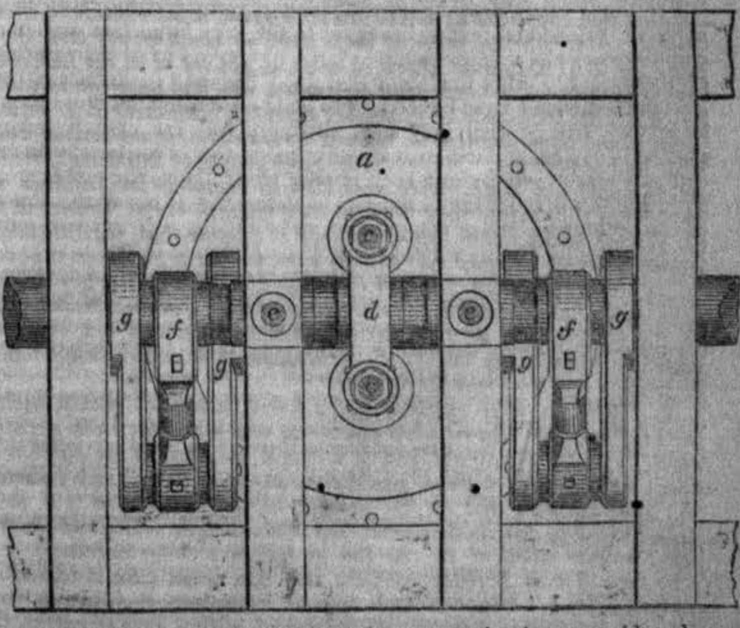


a, cylinder. *c*, *c*, *c*, *c*, the four piston rods. *d*, cross head. *e*, *e*, guide rods *f*, connecting rod. *g g*, crank.

SIR,—Your March number of the Journal contains drawings and a description of Messrs. Maudslay and Field's patented improvements in marine steam-engines, and it is on the second feature of their invention I have presumed to offer a few remarks and suggestions. Moreover, it is generally observed, that when a person obtains a patent right for any invention, it no sooner publicly appears to the mechanical world, than it is followed up by a modification of some sort, that modification being more or less effective, costly, or practical; and it sometimes happens that by means of such modification, schemes which, as they occurred originally to the mind of the inventor, could never have answered, have, in their effect, exceeded his (the original inventor's) most sanguine expectation. However, the inventors in this case are practical men (the most extensive, perhaps, in the kingdom), and it may be thought presumption in me to offer anything which might seem an improvement on their schemes, but my anxiety for the advancement of mechanical science must be my excuse.

It will be seen from the engraving, and it is obvious, that the crank shaft is placed on one side of the piston rods, consequently the action of the piston cannot be communicated to the crank pin in a direct line

Fig. 2.



a, cylinder. *c*, *c*, the two piston rods. *d*, cross head. *e*, *e*, guide rods. *f*, *f*, connecting rods. *g*, *g*, *g*, *g*, cranks.

How far this may answer in practice I don't know, but the theory does not look well.

It will be apparent that the proper place for the crank shaft is in the line of the centre of the centre of pressure, or centre of the cylinder, and to obtain such place, I propose that there be four piston rods uniting in one cross head, as shewn in Fig. 1. The sectional area of the four rods would require to be very little greater than for two or only one rod, but of course there would be the additional friction caused by the enlarged surface.

The arrangement is sufficiently shown in Fig. 1, without any further description.

Fig. 2 is another plan for keeping the shaft in the same central position with only two piston rods; in this case there will require a double cranked shaft as shown, and of course two connecting rods.

By the arrangement in Fig. 2, cylinders of a minimum diameter may be employed.

Messrs. M. & F. may have thought of these methods of combination, or they may not; however, Sir, if you think the above worthy a place in your Journal, nothing would give greater satisfaction to

AMICUS MACHINARUM.

April 8th, 1840.

THE ASSIZE COURTS, LIVERPOOL.

SIR—The decision has just taken place with respect to the designs for the Liverpool Assize Courts, for which no fewer than eighty-five designs had been sent in on the 1st January, and the two lucky competitors to whose lot the premiums have fallen, are Mr. Elmes of London, and Mr. Grieg of Exeter. During the present week there is to be an exhibition of all the drawings at the Town-hall, Liverpool, but the time allowed for its being open is so exceedingly short, that very few professional men here in town, or at distance from Liverpool, will be able to avail themselves of it, more especially as no public notice beforehand has been given of it in the newspapers,—which certainly ought to have been done. Besides which, the same egregious blunder has been here committed,—or if not blunder, the same crooked and perverse policy has been here pursued, which has justly been animadverted upon in similar cases; namely, instead of preceding the decision, the exhibition is not allowed to take place until it is over, and all appeal from it rendered unavailing.

This surely might be remedied—at least might be attempted to be remedied by the Institute, who ought to draw up and publish a protest against such a highly injurious mode of procedure, and ought also for the future, in every similar case of the kind, that is, in a public competition for a building of any magnitude, and in which numerous members of the profession are likely to engage,—to address themselves formally to the committee—or, however, the presiding powers may be styled, and urge upon them the propriety and decency of granting a public pre-exhibition of the designs, and that too, for a reasonable and satisfactory time.

I certainly cannot help being of opinion, that the Institute have been culpably supine and remiss in regard to the very important matter of competition; and negligent both of the interests of architecture and its professors. What they have yet done towards advancing either, I do not know, nor have I been able to learn: probably, let their disposition and zeal be what they may, there are very few cases in which that body can exert itself with any effect; but that becomes only an additional reason wherefore they should exert themselves the more strenuously wherever they can; and in attempting to check the abuses of the present system of competition and establish a better one,—the Institute would, at all events, have public opinion on its side.

As regards the particular competition here mentioned, it does look rather odd that Mr. Elmes, who, but a few months before, had been the successful architect for St. George's Hall, should have obtained a second and still more expensive in the very same town, ere the first one has been fairly commenced. Indeed, it is rather singular that that gentleman should have chosen to enter a second competition immediately after succeeding in a previous one, unless he had particularly good reasons for anticipating success. However, it is to be hoped that his design will be found fully to justify his so extraordinary good fortune, and thereby remove the awkward impression now likely to be made upon those, who at present know only the curious fact itself, and nothing further.

I remain, &c.

April 27th, 1840. Q.

GREAT WESTERN STEAM SHIP COMPANY.

THE annual meeting of the Great Western Steam Ship Company took place on the 28th March, when discussions took place highly interesting, both in a professional and public point of view. The question in dispute is as to the propriety of the steps taken by the Directors in constructing an iron vessel of unparalleled size, and in erecting a manufactory for supplying the public with engines.

The first question is with regard to the size of the vessel, which, as we should state, is to be of 312 feet in length, 42 feet breadth of beam, 32 feet depth of hold, 2500 tons, and with engines of 1000 horses power. The reasons assigned for this step by the Directors are, the increase in stowage afforded by the use of iron, increase of power, and consequently quicker and more certain passages. To these reasons the objections are objections of expediency, and a question of expediency this must be considered in all its bearings, mixed up as it is with the circumstances of the company, and the objects for which it has been projected and carried into effect. It seems that the capital of the company is small, and the difficulty of raising funds at the present time is very great, and consequently, on that account, it is inexpedient to engage in large enterprises, for which the funds are insufficient, and from which the returns cannot be obtained quickly, nor depended on with certainty. What is wanted at the present period is to have more frequent steam communication between England and the United States, so as to make the use of steam habitual, and its advantages permanently manifest, and not to be looked on merely as a casual relief to the regular sailers. It is only in this way that the liners can be successfully competed with, for it seems the saving of time is still so little appreciated, that, by a reduction of fare, they have been enabled successfully to contend with the large steamers, and force them also to reduce their prices. The Great Western, also, at present, has rarely her full complement of passengers, and in the last three trips, there has been a considerable falling off, so that the necessity of a large vessel on the score of accommodation, evidently cannot be asserted. The Company will also, in the course of this year, be subjected to the competition of numerous steamers, so that they will be the more called upon to preserve the regularity of their communications, while they must necessarily have *speedily* a new vessel on the station, not only for the purpose of securing quick returns to the proprietors on their capital, but to prevent them from losing all profit in the event of the temporary or total incapacitation of the Great Western. On all economical grounds, therefore, the construction of a vessel of a larger size than the Great Western is clearly inexpedient, and indeed the proprietors, in giving their consent to the construction of an iron vessel, never contemplated any increase of dimensions. Supposing, even, that the experiment should be successful, the Directors will not even then be exonerated from blame, in having unadvisedly made such an attempt, so uncalled for by the circumstances, and highly perilous to the financial prospects of the Company. We now come to the question of the propriety in an engineering point of view, of engaging in such an undertaking, and we find that not only has it no example, but, from the highest authorities, it meets with no encouragement. We do not say that an iron vessel 312 feet long cannot be constructed, but we must say that it augurs considerable temerity to attempt it in the teeth of the opinion of those most competent to judge. The largest iron steamer which has been built is only of 400 tons, one sixth of the size of the proposed vessel, and Mr. Laird, the engineer, positively refused to contract for an iron vessel of only 1850 tons, so little was he disposed to proceed without some practical result upon which to base his operations. Mr. Ditchbourn, the eminent iron shipbuilder, of London, expressed himself to a similar effect before the Committee on Steam Communication with India. It must be further recollected that the Company's vessel, instead of being under the responsible control of a private builder, is being built in their own yard, so that, should it prove a failure, the proprietors have no remedy. As if to heap experiment on experiment, the Directors have chosen to adopt a form of engine, of which the best that can be said is that it has not succeeded, if, indeed, it be not regarded as a total failure. Humphrys' Patent Engines will be found in another part of the Journal to have been patented as Mr. Broderip's, in 1828, by Col. D'Arcy, and how they ever came to be called after Mr. Humphrys, no one presumes to surmise. A pair of them was put on board the Dartford, built at Gravesend about four years ago, for Messrs. Halls, of Dartford, by Mr. Baulckham. The lines of the Dartford were very fine, and she had a very promising appearance; when, however, her engines came to be put on board, so far was she from justifying the predictions of her proprietors, that they were obliged to give up running her on the Thames, after she had been beaten by most of the boats on the river. She was then being also found to be dissatisfactory, she has been repeatedly offered for sale, without success, at less than half price, and may now be found in the East India Docks with a broom at her masthead. Both Maudslay and Seawards refused to construct engines on this principle, and Mr. A. Mornay has written a paper to show that the trunk engines are good for nothing at all. Mr. Brunel, in defending the character of the Dartford, very gravely assured the Bristolians that she had beaten the "City of Glasgow" by two hours in going to Portsmouth, a fact, which, if true, it is very fortunate for him that he did not state in London, for here the City of Glasgow is a byeword for slowness, a kind of *Regulator*, by which all the other steamers go. Having said thus much, we shall now proceed to show, by a few calculations, the justness of our remarks.

The engines are to have cylinders of 10 feet diameter and 10 feet stroke, and thus, according to the usual computation of 7 lbs. effective pressure on the square inch of the pistons, assuming their speed to be 240 feet per minute, would be equivalent to 1151·5 horses power, if of the ordinary construction; but as they are to be made with the trunk, half the transverse section of the latter must be deducted from the area of the piston, (say one-fifteenth of the area of the piston), by which the nominal power of the engines is reduced to 1075 horses power. They are expected to weigh, without the boilers, one third less than common engines; we may then fairly assume that they will weigh, with the water in the boilers, 800 tons.

It is difficult to imagine the motive which has induced the Directors to cram this *enormous* power into their intended vessel, the proportion of power to tonnage being about what is allowed to small boats; for by so doing they forego the chief advantage which large steamers possess over small ones for long voyages. The natural consequence is that the vessel will be able to carry little or nothing besides the requisite fuel for the voyage across the Atlantic.

The whole area of one of the pistons is 78·54 square feet, from which if we deduct one fifteenth for the half area of the trunk, we shall have for the mean area acted upon by the steam, 73·3 square feet. The mean capacity of one of the cylinders is, therefore, 733 cubic feet. If we suppose the diameter of the paddle wheels to be 36 feet, the vessel cannot be expected to advance more than 83 feet 9 inches for each revolution, which with 12 revolutions per minute, would give a speed of nearly 10 knots an hour, and the voyage from Bristol to New York would require the wheels to make about 220,000 revolutions. For this 880,000 cylinders full of steam will be used, but as under favourable circumstances the steam is to be used expansively, we will suppose it, on an average, to be cut off at half stroke during one half of the voyage, and used at full pressure during the other half. On this hypothesis only 660,000 cylinders, full of full pressure steam, will be expended, exclusive of waste. This is equivalent to 483,780,000 cubic feet of steam, to which if we add 10 per cent for waste, the total expenditure of steam will be 532,158,000 cubic feet. We understand the steam is not to be used at a higher pressure than 4 or 4¼ lb. above the atmosphere; at the former pressure one cubic foot of water is required to generate 1356 cubic feet of steam, so that to produce the above quantity of steam 392,447 cubic feet of water must be evaporated.

Mr. Armstrong in his work on the Boilers of Steam Engines, gives 10 lbs. of coal as the quantity requisite to vaporize one cubic foot of water, but as the usual allowance for marine engines is only 9 lbs., we shall adopt this as the basis of our calculations. On this hypothesis the consumption of coal during the voyage will amount to 1580 tons nearly (say 1600 tons, to allow for emergencies). At the commencement of the voyage the resistance of the water to the vessel's motion will be of course greater than when she is light; and by the consumption of some of her fuel, the engines will not be able to make their full number of revolutions; and it cannot be doubted that under these circumstances a greater amount of fuel will be consumed in the same distance than when going at full speed, so that it will be scarcely safe to take less than 1600 tons on board at Bristol, particularly as the passage out may be reasonably expected to be prolonged by adverse winds, which do not occasion a reduction in the consumption of fuel *proportional* to the diminution of the vessel's speed; for it is clear that, to obtain an equal resistance with fewer revolutions of the paddle wheels, the floats must slip more through the water, and consequently the progress of the vessel must be less for each revolution of the wheels than when she has no contrary wind to contend against. Now the quantity of fuel consumed is proportional to the number of strokes of the engines, therefore the consumption in a given distance, although not proportional to the time occupied, will be greater when the speed is reduced by adverse winds than otherwise.

The directors have announced that the vessels displacement will not exceed her tonnage, or but slightly, and that she will not vary in immersion between Bristol and New York more than 2 feet 6 inches. attempted to be run to several places on the south coast, but this

Now the weight of the hull, masts, yards, sails and rigging, boats, cabins, fittings, &c. cannot be safely estimated at less than	1100 tons
The engines and boilers with water	800
Fuel	1600
Making altogether (without any cargo)	3500 tons.

which is already 1000 tons more than the measured tonnage of the vessel. Her draught of water will, therefore, be 3 feet 6 inches, or perhaps 4 feet more than it is expected to be.

On a rough computation we estimate that the vessel's draught of water will vary about 5 ft. 6 in. during the voyage, by reason of the consumption of 1500 tons of coal; and for this reason, as well as on account of the immense power of her engines, the paddle wheels cannot be made less than 35 feet in diameter, with 32 floats on each, measuring 15 feet in length and 4 feet broad. With a less diameter a speed of 10 knots an hour could not be hoped for with 12 revolutions per minute, even in calm weather, and with smaller or fewer floats the engines would probably over-run their speed, when the vessel was lightened by the consumption of the chief part of the coal. If, therefore, with the floats immersed 4 feet, the wheels make 12 revolutions per minute, and the vessel attains a speed of 10 knots, as assumed above, the engines will be brought up to about 7 or 7½ revolutions at the beginning of the voyage with 1600 tons of coal on board, which would immerse the floats 9 feet 6 inches instead of 4 feet, and the speed of the vessel would most probably not exceed 5¾ to 6¼ knots.

As regards the expense of the new vessel, as estimated by the Directors, we will call attention to the fact that the price per cwt. of angle iron, plates, &c. increases with their weight, and, if the "Rainbow" cost 60*l.* per ton weight of iron (which is the fact), it is not unreasonable to assume that the new vessel will cost 80*l.* per ton; but taking it at 70*l.* only, and the weight at only 650 tons, the hull

alone will cost	£45,500
Adding to this for masts, yards, cabins, stores, &c.	15,000
And for the engines at 35*l.* per horse power	35,000
We find for the cost of the vessel	£95,000

which exceeds her estimated expense by 20,500*l.*, irrespective of all preparations, accessories, buildings, tools, &c.

The tools are to cost 30,000*l.*, out of which we find by the last report that 19,000*l.* was paid, and out of the cost of the vessel 6,800*l.*,

leaving still to be paid for the vessel	£ 88,700
for the work shops	11,000
By the same report there was expended	105,500
Required to pay debts due	11,000
Making in all	£216,200

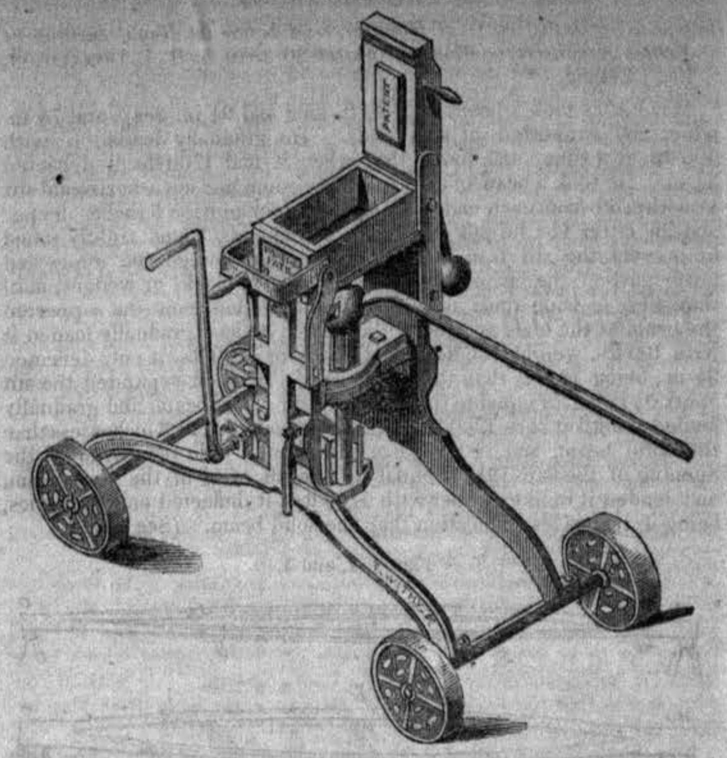
The total number of shares taken falls short of 1,900, and assuming them at that number, and that all calls will be paid, the gross capital of the Company amounts to 190,000*l.*, or 26,200*l.* less than the inevitable disbursements before the completion of the new vessel. Besides this there will be the rent of premises, clerks' salaries, expenses of management, &c. during the term of completion, which cannot be safely estimated at less than two years.

Having shown the temerity with which the directors have acted, both in regard to the size of their vessel, and the engines by which it is to be worked, and having proved that it is inexpedient and injurious, we have next to consider one of the most outrageous propositions that was ever suggested to a public company, that of setting up a factory for making vessels and engines. Without any attempt to ascertain on what terms the vessel and engines might have been constructed by contract, the directors have themselves determined to execute both, and have accordingly already laid out £20,000, being *one fifth* of their capital, in the purchase of leasehold property! in digging docks! and in buying machinery! and as if it were not enough to waste the limited capital of the unfortunate shareholders in such speculations for their own uses, but, as if to add the climax to their proceedings, they actually propose to organize a regular factory for making vessels and engines for whomsoever will buy them. With a capital totally insufficient for the legitimate objects of the Company, and having unadvisedly engaged in a most hazardous and unwarranted speculation, the directors waste the resources of the shareholders on objects which it will require a long time to make available. As to how they propose to find money for finishing this vessel, which will certainly cost much more than their estimates, or for carrying on their extraordinary operations, no one can conceive, unless they are to bring half shares into the market to divide equally with the original proprietors. To aggravate the injury in particular cases, they are literally employing the money of Mr. Acraman, the great engineer, in competing with himself. With regard to the legality of their proceedings, it requires very little knowledge of law to be aware that it is only under a new deed of settlement that the directors can carry out any such plans. As to the propriety of engaging as rivals to private manufacturers, public opinion is too strongly against such a practice to render any further comment necessary, while, as concerns the shareholders, if this departure be allowed from their original plans, there is no reason why the Directors should not set up chain-cable works, rope walks, sail lofts, machine biscuit bakeries, or anything connected or not connected with shipping,—they may engage in banking, life assurance, or any pursuit.

We cannot, therefore, but be of opinion that, on every point, the Directors are not only totally unwarranted in the course they have pursued, but are open to severe reprobation for their imprudent management of the affairs of the shareholders, whose property must, by such proceedings, be rendered more unsaleable than it is even at present. The future operations of the Company are in every way embarrassed, both by the mismanagement of the capital, and the heavy charge that must be created by such a lumbersome vessel and expensive establishment, which must be kept up, whatever may be the revenues of the Company. The report which recommends and justifies the course adopted, is of a most fulsome and trumpery character, with the stamp of official paternity strongly marked; the self-laudation is too apparent to be disguised, and, like on passing the line, every one of the novices is abundantly bedaubed with the glittering slime of the concoctors. The phraseology is as rich as the matter of which it is the vehicle, and renders the whole affair still more sickening. We do not think it necessary to give the report any lengthened examination, or we should waste the time of our readers and our own in exposing this tissue of egotism and presumption. Among other information which we see with regret is, that the Company have been compelled to accede to the grievous demands of the Dock Company, and pay a large sum for docks their vessels can never enter. They were obliged to take off the paddle-boxes of the Great Western to get it into Cumberland Basin, and, as if to make the difficulty greater the new iron vessel will be seven feet wider. This is making a man too large for his house with a vengeance, and we very little question that the Great Western Directors will, in time, in their zeal for the interests of Bristol, make their vessels so large that they will not be able to get up to the city at all. The experience and observation of the Directors and officials is very much praised, but if we are to judge by one example, we fear a little too much. They coolly state that a modification of the Great Western's paddle-wheels has been made, founded upon the results of accurate observations during her voyages, which modification, if we are informed rightly, so far from being an improvement, has had the effectual result of reducing the speed of the vessel. The *sang-froid* with which they mention the superiority of themselves and their yard is admirable; it shows a becoming obliviousness of the Maudslays, Millers, Boltons, Acramans, Seawards, Fawcetts, Napiers, &c.; their confidence in the estimates and opinions of the most eminent manufacturers is rich, the persons answering to this description are, the patrons of the Trunk Engines, Messrs. Halls, of Dartford, and a most eminent and practical man, in whom they put their trust, is Mr. John Scott Russell. Well may the directors talk about its being for *the interest of the shareholders that their singular appliances should be directed to manufacture and repair for other parties*, if they believe that any one can feel any confidence in their ignorance and quackery. We leave this subject with an earnest entreaty of the shareholders concerned to look about them, and get their affairs out of the hands by which they are at present mismanaged, or the end of the experiments will be the total ruin of their property.

Steam-Plough.—A trial was lately made in one of the fields on the estate of Fossil, near Glasgow, of the steam-plough, intended for the cultivation of the sugar lands of British Guiana. This trial was completely successful, and gave great satisfaction to the numerous party who witnessed it. The field was laid out similar to those in the colony, which have canals on each side running parallel with one another. The machinery consists of two iron boats, one containing a small high-pressure steam-engine, with a drum, round which the endless chain or rope is coiled, and the other a reversing pulley, by means of which the chain or rope is extended, and allowed to work whichever way is required; the ploughs are attached to this chain, and made to work backwards and forwards with great rapidity and accuracy. Mr. MacRae, whose long residence in the colony, and great practical experience of the working of sugar estates, had directed his attention, for a considerable time past, to the great and absolute necessity of employing some other power to supersede cultivation by manual labour, invented the steam-plough, which was executed by those enterprising engineers Messrs. Thomas Edington and Sons, Phœnix Iron-works, whose great ingenuity in constructing and designing the various parts was very much admired.—*Glasgow Courier.*

BAKEWELL'S PATENT BRICK MACHINE.



This machine is strong, of simple construction, and made of cast iron. The mould for receiving the brick is fixed at the top, the inside being accurately ground, and the bottom made to slide freely up and down, when operated upon by the screw and lever underneath; the top is made with a counterbalancing weight by which it is easily opened on withdrawing the catch that secured it. A winch is likewise connected with the underside of the mould to raise the brick after it has been pressed.

The process for pressing the bricks is as follows:—The bricks when half dried are placed in the mould, the lid closed and secured, the bottom is then forced up with a pressure of from 4 or 5 tons, by means of the screw acted upon by the horizontal lever. The brick is then raised out of the mould by simply forcing back the winch and removed by a boy; the bottom is then lowered by its own gravity, and is ready for another operation: by the aid of this press, between two and three thousand bricks may be pressed in a day with the labour of one man and two boys.

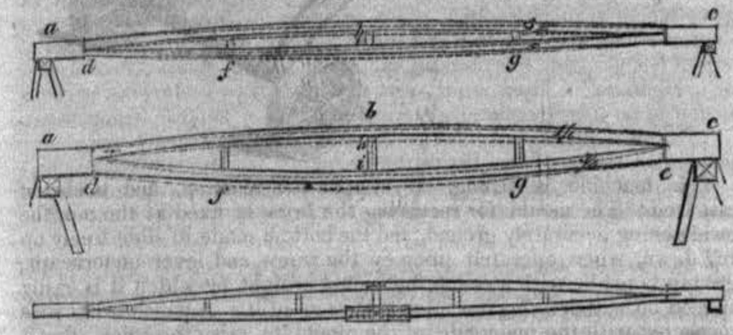
It will be seen that this machine does not profess to make the bricks, but is intended to improve them when made; this it accomplishes in a superior degree; the bricks when turned out of the mould have the sides smooth, and the arrises perfect and parallel, and when burnt, they retain their form, and are of great hardness; they are consequently, well adapted for facings of buildings and paving, as the joints can be laid quite close and regular, the bricks being all of an exact size: they are equally desirable, on account of their extreme hardness and near impermeability to water, for engineering works; particularly for arches and abutments, viaducts and bridges, foundations, retaining and dock walls, and other works requiring great resistance. The press may also be used for quarries or fancy bricks, which can be pressed to almost any form by merely changing the mould. This press has been in use for many years, more particularly in the midland counties where several public buildings have been faced with these bricks, which gives them a very superior character, far surpassing the bricks commonly applied to that purpose; and although the machine has been used very extensive by Mr. Rhodes, it is not much known in London. The front of Bielefield's extensive Papier Maché Works, in Wellington-street, are faced with bricks of this description. We understand that several parties are now in treaty for licenses, and that the introduction will shortly become very general. The extra cost of the bricks will be from five to seven shillings per thousand;—a sum comparatively small, for the superior quality of the brick, which cannot add very greatly to the cost of the building when used for facings only. The miserable looking brick buildings at the several railway stations, would have been much benefited by them, as they now exhibit generally a very mean and stable like appearance, which a clean well coloured facing brick, at but small cost, would have been easily prevented. We with pleasure recommend the attention of the profession to this important patent, which can be viewed at the proprietor's office, Adelphi Chambers.

ON TRUSSED BEAMS.

Invented by HERR LAVES *of Hanover, read before the Royal Institute of British Architects, on Monday, March* 20, 1840, *by* T. L. DONALDSON, ESQ., Fellow.

MR. LAVES took a beam of fir 40 ft. long and $9\frac{1}{4}$ in. deep, and $7\frac{1}{2}$ in. wide, and supported at the ends. He gradually loaded it with 100 lbs. at a time, and found that when it had 1700 lbs. it deflected $5\frac{1}{4}$ in. He took a beam of the same dimensions and cut a horizontal slit to within 3·6 from each end, making the upper portion 5 inches deeper and the latter $4\frac{1}{4}$; he put iron straps at the ends, bound tightly round to prevent the slit from extending—he then forced the upper and lower part of the beam asunder by driving in blocks or wedges, until they were as wide apart as half the depth of the beam—he supported the beam at the ends and found that when he had gradually loaded it with 100 lbs. weight as before, until it bore 1700 lbs. it only deflected $3\frac{1}{2}$ in., being $1\frac{3}{4}$ less than the solid beam. He then separated the slit apart $9\frac{1}{4}$ inchei or equal to the whole depth of the beam, and gradually loaded it until it bore 1700 lbs., when it deflected $2\frac{1}{4}$ or 3 inches less than the solid beam, and $1\frac{1}{4}$ less than the former. He then widened the opening of the slit $13\frac{1}{2}$, or equal to a depth of $1\frac{1}{2}$ of the solid beam, and loaded it in like manner with 1700 lbs., it deflected only $1\frac{1}{5}$ inches, being 4 inches less deflection than the solid beam. (See Fig. 1.)

Figs. 1, 2, and 3.



He then took pieces of fir 50 in. long, 2 in. deep, and 1 in. wide, one was left solid, two others were slit so as to make the upper part $1\frac{1}{4}$ inches deep, and the under $\frac{3}{4}$ in., one piece having the slit half the depth of the beam apart, the other $\frac{3}{4}$ of the depth apart. See fig. 2.

It will be perceived that the principle of this system consists in the combination of the two chief forces of materials, that is resistance to compression, and resistance to tension.

Resistance to compression is the one employed from the remotest periods in the construction of arches and vaulting, and requires great masses of materials; and resistance to tension has more lately been employed, at least in Europe, for the construction of suspension bridges by the application of chains, and requires less materials than the other principle of compression, but frequently the insertion and use of chains is obtained with difficulty, and produces vibrations and sensibly felt undulations.

These inconveniences have led to the application of this system. It will be perceived that the under line or chain attached at the two extremities of the upper curved line acts with positive force that of tension, which is the greatest possible force of materials varying from 10 to 20,000 lbs. on the square inch of the transverse section in various woods used in construction, and from 20 to 100,000 lbs. in metals.

The upper line or beam acts by relative force that of compression, and serves to prevent the lower line or chain from contracting the two extremities.

The lower line or chain hinders the upper line or beam from pressing out at the extremities.

The supports and braces serve to unite the upper and lower lines or beam and chain together, and then two forces neutralized form a complete whole, which sustains itself, and can neither thrust out nor draw in.

It is to be observed—1st. That the force of the chain is dependent upon the depth of the versed sine, and that the lower it is beneath the horizontal line or chord of the arc the stronger it will be. Arches of solid construction require a rise of 20 or 15 ft. for the springing of the arch to the soffit of the key stone, in a span of 100 ft; but the chains in this system, if they have a rise or versed sine equal to 4 ft. 2 in. in a span of 100 feet, the force of the chain reduces itself to one-third of the absolute product—if the rise or versed sine equal 6 ft. 3 in. in the same span of 100 ft., the absolute force could be reduced a half.

Observe 2dly. That the upper line or beam, on account of the elasticity of the materials, ought absolutely to have the convex form as in the diagrams, in order that when considerably loaded, the lengthening of the under line or chain by tension, and the shortening of the upper line or beam by compression, may not reduce the upper curved line to an horizontal one, beneath which it would no longer serve by resistance to the statical equilibrium of the construction.

We observe, 3rdly, That the method of tying together the extremities of the curved lines will depend on the materials employed, and must be calculated according to the weights that they will have to bear.

Such are the general principles of this system when applied in a horizontal direction.

We will now consider its application in a vertical or upright direction, and when used obliquely.

It is obvious that the resistance of a story post or stay, whether in wood or metal, increases in a fixed proportion according to its thickness.

For wood—the pieces of wood are sawn as before described with one cut, or two cross cuts to within a certain length of the ends, and these tied together by bolts or straps of iron. The cuts are then forced apart by wedged blocks and kept in their places by bolts or straps of iron.

For iron—by connecting together at the ends, two or more bars of iron, and separating the bars by wedges or pieces of iron, or iron rings.

The proportions and number of the different parts as chains, stays, posts, &c., depend upon the purposes to which they may be applied, and must of course be calculated accordingly by the architect.

The most simple practical application of this system is for the purpose of wooden bridges, and the upper line or beam may be materially strengthened, and the combination stiffened by the introduction of stays and braces.

If the span of the bridge exceed the length of one beam, two may be taken, sawn at one end only, and connected by two scarfing pieces, into which they must be fitted with notches, and bolted or strapped together so as to prevent their separating.—See fig. 3.

In those parts where the ends of timbers abut upon any joints or other timbers, it will be expedient to interpose thin plates of copper or iron, in order to prevent the but ends from driving by the force of compression into the beams, which would cause a sinking.

For occasional purposes or military operations it may be useful to adopt the same system applied to rough trees, which would even be picturesque and useful in parks and gardens—and by connecting the forked branches of two trees, to produce a combination which would answer every purpose.

For all the bridges hitherto described, it will be sufficient that the versed sine of the lower arc or chain equal $\frac{4}{100}$ or $\frac{1}{25}$ of the span. This is very moderate, for a beam requires $\frac{3}{100}$ or $\frac{1}{33}$ of the span, and bridges or arches of masonry or solid construction, a rise of $\frac{15}{100}$ of the span.

If the banks of a stream be too wide apart to admit the adoption of this system in one span, it will be necessary to have intermediate piers or columns, and to form a succession of framings tied together with iron straps, or constructed in cast iron.

If the bank of a river be too little elevated above high water mark, or if it were requisite to give greater height in the middle of a series of arches, in order to admit the passage of vessels, the lateral framings admit of a gradual fall to the banks without affecting the stability of the framing.

Various bridges upon Mr. Laves principle have been constructed.

1. One in oak at Hanover for foot passengers—the span 100 feet, width 12 feet—cost about 112*l.*

2. One in oak over the Nette river at Dernebourg, near Hildesheim—span 60 feet, breadth 15 feet, it being for carriages—cost about 70*l.*

3. One in oak for foot passengers, and a water pipe at Dernebourg, near Hildesheim—span 30 feet, breadth 10 feet—cost 26*l.*

4. One in fir for foot passengers over the Eger at Elnbogen, in Bohemia—length 36 feet, width 5 feet—cost 50*s.*

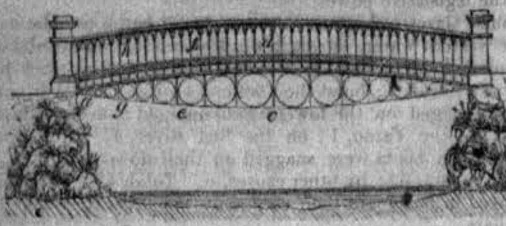
5. One in fir for carriages over the Eger at Altsaltel, in Bohemia, in two lengths, supported in the middle or junction of the two—total length 126 feet, width 15 feet—cost about 100*l.*

6. One for carriages in wrought and cast iron, in the Royal Park of Herrenhausen, near Hanover—length 83 feet width 20 feet—cost about 550*l.*, comprising the wood paving for the carriage way.

Besides others at Salzau, near Kiel, in the Royal Park at Hanover, and one for the Count Munster at Dernebourg, near Hildesheim, varying from 22 to 42 feet span, and constructed in iron at a very moderate cost, all of which are described in Mr. Laves' pamphlet.

Figure 4 explains the construction of an iron bridge over a river, the upper line consists of hollow cast iron cylinders united by bands of wrought iron. The chain is of wrought iron, and the rings may be made either of wrought or cast iron. The hollow cylinders are for the purpose of producing lightness in the upper line, which is essential.

Fig. 4.



The application of this system to roofs and floors is extremely economical and useful, and by simple modifications serves for the covering of large spaces without any intermediate point of support, and presents this further advantage, that from its vertical pressure it requires no other support than walls of moderate thickness.

When applied to floors, bridging joists will remedy the inequality of surface in the beam itself.

In roofs of large span the posts may be continued up so as to receive the purlins, and when continued downwards serve to hold up the ceiling, whether flat, or vaulted, or mixed.

The principal rafters of a roof may derive considerable strength from being treated in the same way as in fig. 2, which combination is calculated for roofs of 50 feet span; by this arrangement of the principal rafters at distances of 10 feet apart, no intermediate stays or posts are necessary to support the purlins, so that a fine clear span space is left in the roof. Here the tie beam is slit according to Mr. Laves' system, and acquires sufficient strength to support itself without being tied up to a truss.

Mr. Laves has applied this principle to various roofs.

One in iron over the kitchen in the Royal Park at Hanover; one in carpentry of 50 feet span, over a barn belonging to the Baron of Wangenheim, at Wangenheim, near Gotha; and likewise one at Hersum, near Hildesheim, and over the scenery magazine of the theatre at Hanover.

The painting room of the scenery in the theatre at Hanover has the slope of the roof formed by rafters, slit down the middle and kept apart—the span 38 feet in the clear, and length 74 feet.

Another application of this system is to large ladders, which when very long, whether used for fires, to scale batteries of beseiged towns, or to board ships, had the inconvenience of being cumbersome, difficult of conveyance from one part to another, so that they could be managed only by numerous assistants; hence they were comparatively little serviceable for the end proposed, and frequently not able to be brought in time sufficient to render the assistance required.

In the case of ladders each of the sides of the ladder is sawn in two to within a certain distance from the ends, which are bound together by iron belts or straps. The intermediate stays, used to keep open the cut, also serve to combine the forces of the two parts, and being continued are useful to receive a side cord, as an additional security to a person ascending or descending. A ladder so constructed may be placed in a horizontal position, and is sufficiently stiff to act as a temporary bridge or scaffolding, from the window of one house to that of another on the opposite side of the street, or from one vessel to another.

If the chain be formed of iron wire, it would answer the purpose equally well, and be tighter.

If it be desirable to place the ladder in a slightly inclined direction, without any immediate object to rest against, two props or supports should be placed against the uppermost rail or round, which, to avoid oscillation or bending, should also be composed of slight pieces of timber, sawn down the centre, kept apart by small intermediate blocks, and bound at the ends as already described.

Mr. Moore's patent Plan for Feeding Furnaces, &c. Fires, for the Consumption of Smoke.—Mr. Moore proposes to have the grate-bars hollow semi-cylinders, with the concavities upwards. The fuel is put into a similar semi-cylinder scoop capable of sliding within either of the grate-bars, and being thrust in from end to end, is turned half round, and then withdrawn, leaving the fuel in the same cylinder bars, which is ignited from the burning coals above. The patentee says he has never found any difficulty in the scoop's forcing out the burnt fuel already in the grate-bars, and that the fire, by this contrivance, never wants any more stirring than is given by the introduction of the new fuel. Of course, the smoke is ignited and consumed by passing up through the red-hot coals above.—*Railway Magazine.*

STEAM NAVIGATION.

The bold front shown by the Engineers and Steam Ship Builders, has shaken Mr. Labouchere's confidence in the propriety of the measure of which he is the official custodian, and, like a prim old maiden distrustful of the legitimacy of the little darling which she had been parading with so much delight, is prepared to modify his trust. He expresses his hope that the measure, as modified, will contain nothing distasteful to the engineers, and appears extremely anxious not to go at once into a discussion on the grievance. We hope that the engineers will think as we do, that this is not a question to be compromised, nor is it prudent to allow such a threatening attack to pass without notice, for the animus is too evident not to render the introduction of the bill certain, whenever its concocters can watch a fitting opportunity; we therefore warn all concerned to be prepared at a moment's notice to oppose this obnoxious measure.

We have felt ourselves strengthened in the course we have adopted, in the consideration of this momentous question, by an able memorial which was addressed to Congress in February last, by the proprietors and managers of steam-boats in the United States, who, so far from concurring in the wisdom, even of the modified code brought forward as an example by our commissioners, boldly declare its injustice and inefficiency. Fearless of all the exaggerated horrors of newspaper paragraphs, and of the facts and pseudo facts raked up by government authorities, they claim at once for steam navigation "a degree of security in the transportation of persons and property, which has not been equalled by any other known means of transport or navigation." They assert, also, that the present degree of security is due to no interference of government with mechanical arrangements or prudential management, or to the enforcement of novel and severe principles of legislation, but to the inventive and discriminative powers, prudent foresight, and persevering spirit, of those engaged in that important branch of public enterprise. The memorialists go on further to urge,

"That certain enactments of peculiar novelty and severity, found in the act of Congress of July, 1838, are calculated to bear harshly and oppressively upon the owners of steam vessels, and thus to affect injuriously, this important branch of our navigation. These enactments, instead of furnishing encouragement for a just and generous rivalry, in bringing steam vessels and their machinery to the highest possible state of security and perfection, have, unfortunately, in the view of your memorialists, a direct tendency to deter men of prudence, capacity and property, from further connexion with this business; who are unwilling to submit to implied reproach and degradation, to unwarranted hazards, and to the loss of rights and privileges which are guarantied to all other persons engaged in a lawful calling. Your memorialists refer more especially, to the clause which deprives them of the universal legal protection common to every civilized country, by unjustly construing, in the event of any serious disaster to life and property, the presumption of innocence into *prima facie* evidence of guilt: and they respectfully request of your honourable body, that a provision which is so much at variance with their fundamental rights and privileges as American citizens, may be repealed.

"It is with painful regret that your memorialists have noticed an attempt to procure a broader and more mischievous application of this unjust principle, by means of proposed additions to this law; and they respectfully ask of Congress to be protected from such proposed aggravations of the already severe and relentless doctrines of the common law as it now governs the responsibilities of common carriers; and which, if enacted, must tend to destroy every just inducement for longer continuance in a business which is subjected to such unprecedented liabilities to loss and ruin. These extraordinary hasards and liabilities, it should be noticed, will not pertain to our competitors under a foreign flag; and our citizens may thus be virtually excluded from navigating the ocean by steam. Your memorialists would further remark, that if with the best knowledge possessed by this or any other country, this species of navigation be deemed too hazardous for the public safety, they deem it more just and honourable to submit to its entire prohibition.

"Your memorialists believe that few opinions are more erroneous than that which ascribes to the provisions of the existing law a generally increased safety for persons and property carried in steam boats. This may appear from the many accidents or disasters of a serious character which have taken place during the short period in which this law has been in force. The number of these accidents on the western waters during the last year is stated to have been forty; which may serve to convince Congress that the appropriate remedies for these disasters are not furnished by this law; and can be found only in the increasing practical knowledge and skill of those persons who are engaged in the construction and management of steam vessels.

"Your memorialists do not seek to escape from any just responsibilities in conducting this important business. On the contrary, they feel bound to furnish every reasonable guaranty for safety to life and property which human foresight and prudence may be able to afford: and it is for the purpose of furnishing these guaranties in the most direct and practical manner, that they further respectfully but earnestly request, that Congress will call to the aid of its committees, to whose protection this important branch of navigation has been intrusted, the information and experience of some of the individuals whose lives have been devoted to its improvement and practice from its earliest origin in this country :—in order that practical knowledge may form the basis of legislation upon a subject which affects more or less directly the interests and business of, probably, a great majority of the American people."

The memorialists here declare, unequivocally, that such restrictions, instead of producing improvement, must retard the progress of science, and check the employment of capital, without, at the same time, ensuring the objects, which they are intended to effect. To show how little desirous they are of concealing facts, and how little daunted by the exaggerations of their opponents, the memorialists append to their pamphlet Messrs. Pringle's and Parke's concoction of one hundred accidents, which have occurred to English steam-vessels, leaving the ungullible portion of the public to form their own comments on the case. These commissioners remind us of the quack who attempted to frighten the old lady out of her tea, by assuring her that it contained a millionth part of prussic acid, and that it would certainly carry her off. "A very slow poison," said she, "for it has been eighty years about it already." Facts show that the loss of life by English steamers, in the very worst year, 1838, was not one twentieth of the number annually lost in sailing vessels, and the amount of property not one fiftieth. On the coasts of the United States last year, above 400 sailing vessels were lost, and 1000 lives. On the New York waters the contrast is as strong.

"Those who have laboured to inflame the public against these unfortunate men may well be reminded, that it is now thirty years since the public have enjoyed the use of passenger vessels impelled by fire and steam, and that during this period not less than *thirty millions of persons* have been transported from time to time, in the various steam boats which have run to and from the city of New York, and that these steam boats have probably navigated a distance equal to *fifteen millions of miles*, and that in all this prolonged and varied exposure, *never, but once, has a single life been lost by the burning of a steam boat.* This fact alone, to the unprejudiced, speaks volumes in favour of the general care and skill of the parties, who have been concerned in this species of navigation."

To expose the absurdity of the protection law, and to give a fair idea of what it may be expected to produce here, we give the following table of known accidents and disasters to American steam-boats since the law of 1838, which was to have been such a palladium to the old women.

1838 Oct. 27th	Cynthia,	Detroit River,	Burnt; passengers and crew saved by running on shore.
Nov. 25	Gen. Brown,	Mississippi,	Explosion, thirty lives lost.
1839 January	Clarendon,	Sav. & Darien,	Burnt; crew and passengers saved.
,,	Ploughboy,	Mobile,	Sunk, on arriving at Mobile.
,,	Somerville,	Mississippi,	Sunk.
February	Oswego,	Ohio,	Sunk, near the mouth of the Kentucky.
,,	Alert,	Mississippi,	Eruption of steam; 4 scalded.
,,	Alice,	Pearl river,	Sunk.
March	Reporter,	Ohio,	Eruption of steam; 4 scalded.
,,	New York,	New Haven,	Burnt.
May	Avalanche,	Ohio,	Eruption or collapse; 5 killed.
,,	Rhine,	Missouri,	Explosion.
,,	Pilot,	Mississippi,	Explosion or collapse.
,,	Ponchartrain,	New Orleans for Tampico,	Explosion.
,,	Geo. Collier,	Mississippi,	Eruption of steam; forty-five killed or scalded.
,,	Erie,	Hudson river,	Collapse, 1 slightly wounded.
,,	Bee,	Arkansas,	Sunk.
,,	Indian,	,,	Sunk.
,,	Buckeye,	Mississippi,	Explosion; several killed or wounded.
June	Empire,	Ohio,	Sunk.
,,	Massillon,	,,	Collision and eruption of steam.
,,	Tennessee,	Cumberland river.	Burnt and sunk; passengers saved.
Nov.	Wilmington,	Mississippi,	Explosion; nineteen killed or wounded.
1840	Gallatin,	Cumberland river,	Collapse; three scalded.
,,	Lexington,	Long Island Sound,	Burnt; about 124 lives lost.

"It may be seen that the most numerous and fatal of the accidents by steam have happened soon after the semi-annual inspections of the first of April and October. This fact will not appear surprising to practical men; who fully understand that the care and skill of official inspectors, cannot be advantageously substituted for the uncontrolled vigilance and practical knowledge and skill, of those who are in the constant care and superintendence of the boats and engines; and to whom a good reputation, the desire of safety and the love of life, afford stronger and more efficient motives to correct action, than can ever be furnished by the requirements or penalties of special enactments of the legislative power.

"The Cincinnati Gazette is stated to have published a list of steam boat disasters on the western waters during the last year. The sum total of losses is 40; of this number, 32 were an entire loss; snagged, 21; struck rocks, or other obstacles, 7; burnt, 5; burst their boilers, 4; run into other boats, 3—40. There were snagged on the lower Mississippi, 11; on the Missouri, 4; on the Ohio, 4; on the Yazoo, 1; on the Red River, 1. It is remarkable that a majority of the boats were snagged on their downward trips. Lives lost, by bursting boilers, 39; by other causes, 6. Total, 45. The amount of property destroyed in boats and their cargoes, is supposed to be not less than a million of dollars.

"On events like these, the provisions of statutory law can have but little influence; except as they may operate to deter the men of means, foresight and mental ability, from a business already too hazardous to their private interests, and which, most unwisely, has been made subject to the proscriptive action of the popular press, and of the national legislature."

Another extract gives a more powerful lesson.

"That the safety of steam boilers from explosions, does not necessarily depend upon working with so low a pressure as five or seven pounds to the square inch, and that a reasonable increase in the proportionate strength of the boilers in steam vessels would remove all immediate hazard, and nearly end the catalogue of these disasters, is rendered apparent by the facts which relate to this branch of navigation, as it has been carried on in various directions from the city and port of New York. Here, where steam navigation was first successfully established, and where it has probably attained its highest degree of efficiency, we might have expected that accidents and disasters would, not unfrequently, attend the use of a power at once so novel and energetic. The accidents and fatalities which have here occurred, as well as their probable proportion to the pressure of steam, the number of boats employed or trips made, the number of miles navigated, and the number of passengers which from time to time have been exposed, are set forth in a table.

"The table, so far as relates to the service performed on the different routes and the number of persons exposed, is made up approximately, by estimates founded on my general acquaintance with our steam navigation; but is believed to be sufficiently correct for general purposes. I have separated the business of the fifteen years which it comprises, into three several periods of five years each, commencing with 1824; early in which year the navigation, in this state, which had previously been controlled by the associates of Fulton and Livingston, was thrown open to all competitors.

"It appears from the average results of the table, that during even the first period of five years after the navigation was thrown open to public competition, the ratio of steam accidents was only equal to one, for more than 20,000 trips or passages; and that the average loss of life was only equal to one, for more than 126,000 passengers exposed. Thus, at the fair outset of this noble enterprise, a degree of safety was attained for the passenger, such as may well challenge comparison with any artificial means of transit or locomotion that have ever been resorted to by the human race.

"It appears further, on comparing the results for these several periods, that the ratio of steam accidents for the first and third periods, as compared with the probable number of trips made, has decreased from one in 20,317, for the first period, to one in 317,105, for the third or latest period; showing a diminution of the ratio of accidents in the average period of ten years equal to *about* 84 *per cent*. The ratio of lives lost from these accidents during the same period, has also decreased from one in 126,211, to one in 1,985,787; equal also to a diminution in the ratio of personal hazard, in this short period, *of* 84 *per cent*.

"It appears also from the table, that during the first of these periods the average number of miles navigated by all our steam boats, to each explosion which occurred, was equal to 235,646: a distance equal to many times the circumference of our globe, and about equal to that from the earth to the moon. But even this ratio has been rendered tenfold more favourable in the short average period of ten years, being for the latest five years, 2,733,725 miles navigated for each explosion; or more than eleven times the distance from the earth to the moon; and reducing the ratio of hazards in proportion to distance, *almost* 90 *per cent*.

"This remarkable diminution of accidents and hazard, it may be seen, has taken place in the very period in which the average working pressure of steam has been more than doubled. It has also been attained solely by professional skill and experience, and without any aid from legislative interference; for the law of Congress on this subject was not in force till near the close of the year 1838. Had such a system of legislation been at first adopted, there are sound reasons for concluding that it would not have prevented disasters, but might have greatly retarded the rapid advance in safety, as well as improvement, which has been so happily attained."

It is thus seen that with an increase of pressure a decrease has taken place in the number of casualties. In the first period the estimated average pressure was 7 lbs.; in the second period 14 lbs.; and in the last period 18 lbs.

We cannot conclude this better than by laying before our readers the eloquent vindication of Western steam navigation, which was given before Congress by the Hon. Mr. Rumsey, of Kentucky.

> "Sir, you have no arithmetic of powers vast enough, by which to estimate the benefits of the steam boat in a pecuniary point of view alone. Its labours, too, have tended, in no small degree, *to the preservation of human life.* I am aware that the truth of the last assertion may not be universally admitted; but it will scarcely be questioned, at least by a western or south-western man, who recollects the old mode of conducting our commerce. Small as the commerce was before the introduction of the steam boat, it drew off a larger portion of the population than is now necessary to transact it, although so immensely extended. Even then, more died in the long, and exposed, and laborious voyages in keels and barges, or the exhausting return by land, under a vertical sun, than now perish by steam boat explosions. But they dropped off one by one; they sank obscurely into the grave by the way-side; or, after reaching their homes, fell victims to disease incurred by a sojourn and travel in southern climes. The consumption of life, though known to be great in the aggregate, happening so much in detail, made no public impression. But now, every steam boat accident creates a sensation, and is proclaimed in the universal press of the country. If the mighty commerce now in progress on the western waters, had to be conducted in the old way, it would require the agency of so many individuals, that it would not be long before the sides of the public roads from New Orleans to the Upper States, and the banks of the great river which pours into the gulf the congregated waters of nearly half a continent, would be almost continued grave-yards."

NOTES OF THE MONTH.

This month has been more fertile in deaths than in any thing else. In this number is Thomas Drummond, Lieutenant in the Royal Engineers, F.R.S., Under Secretary of State for Ireland, &c. His labours in the Ordnance Survey of Ireland, and his discovery of the hydro-oxygen light, which bears his name, are well known to the public. As an Irish Railway Commissioner it was our lot to oppose him, but we are free to confess that it was to Drummond that the report was indebted for its most valuable portions. He died on the 18th ult., at Dublin, and was honoured with a public funeral, which he highly merited.

Pitts, the sculptor, unfortunately committed suicide on the 16th ult., in his 50th year. He was an artist of high merit, who it is to be hoped will receive that honour now which he pined for in his lifetime. Among his works are the Shield of Eneas, from Virgil, and that of Hercules, from Hesiod, compositions and designs from Virgil and Ossian, intended to be published in the same form as Flaxman's from Homer, the Nuptials of Perithous, the Apotheosis of the English poets, and several other reliefs which adorn Buckingham Palace. The Brunswick Shield was another of his works.—The Chevalier Gasse is also dead. He was architect to the King of Naples, Corresponding Member of the French Institute, and of the Institute of British Architects.

The Easter holidays have given some check to business, so that we have little to record. Spencer's Electrotype is now receiving the attention which it deserves; some months ago it was smothered under the blaze of photography. Seals and copies of medals are made by this means with great accuracy and celerity.—Jacobi's galvanic engraving is also acquiring publicity. We may mention by the bye that as his other electric inventions have not exceeded those of our countrymen, so his application of electro magnetism as a motive power is derived from an Englishman.—Smee's battery described in our present number will give fresh power to the professors of this important branch of science.—Claudet and Houghton's specimens of Daguerre's process of photography now exhibiting in Holborn, are well worthy of inspection, they give good earnest of the aid this admirable invention will afford to the arts. Its application to the delineation of architectural and antiquarian subjects will make it of great value to the profession. The Elgin marbles should be copied by this method.

The vacuum engine is the wonder next to be exhibited; a new application of agriculture, by which it is said, above twenty square miles can be cultivated by one stationary engine has been patented, and will be shown to the public on a small scale early in the ensuing month.—It will be recollected that Hague's draining apparatus is on this plan, and a steam engine erected by Mr. Hague at Constantinople, works a powder mill seven miles off, at a place where the Grand Signor refused to allow any steam engine to be erected within that distance.—Mr. Maugham, the lecturer on chemistry, has removed from the Adelaide Gallery to the Poletechnic. At this latter Institution an ingenious application of propellers to the balloon is shown, although their success on a large scale is doubtful, from their incapacity to contend with currents of air.

The plan for embankment of the Thames is now before the legislature, so that we may expect, something as a beginning.—The wood pavement companies are getting on faster than the asphalte, they are at work at Buckingham Palace, in the Strand, Oxford Street, St. Giles's, and Lamb's Conduit Street The elasticity of this material forms one of its best properties. Under most of these pavements a firm bed of concrete mixed with Roman cement and puzzolano is laid, rather expensive we should think.

The Marine Gallery at Hampton Court Palace was opened on Easter Monday, so that the maritime nation has at last two marine galleries.—The Government School of Design at Somerset House has made another step out of the humdrum system; having obtained a set of casts from Messrs. Lofts in Dean-street. How they could persevere in their exclusion of the figure, it is difficult to conceive; they have only to go into their own schools and look at the drawings of the same ornaments affixed to the walls; those from casts are full of life and spirit, and in high relief, those from engravings more laboured are dead and flat. In fact the wisest thing they could do would be to turn every engraving out of the school, where they can substitute nature or casts, and above all never to let a boy begin to draw from a drawing,—set him before the Apollo or the Venus at once. This has been tried at the Leicester-square school with full success, even on its very young boys. The latter is far before Somerset House in principle; thanks to their badly remunerated Director Mr. De Mouchet. The modelling class at Leicester-square gets on well. We hope the inspection of Mr. Wyse at Somerset House last month will do some good; that patron of the arts has, it is said, suggested many modifications in the establishment. One fruit of his visit is a report from the council, the first since their institution. Pretty fair from a national establishment! It is a pity these establishments are not more frequented, where the working classes can obtain first rate instruction in the arts for *sixpence a week.* The whole number of students at the school is not more than two hundred.

Pneumatic Experiment on the Birmingham, Bristol, and Thames Junction Railway.—The engine-house is built, and the communicating tube between it and the railway, by which the exhaustion of the main tube is to be effected, is nearly laid. The permanent way and rails are also almost completed, and fit for the laying down of the tubes for a considerable distance out of the 1¼ miles on which the experiment is to be made. We perceive also that a great many of these tubes are already arrived and on the ground. They are nine inches diameter, and are lined inside, to about the tenth of an inch thick, with a hard unctuous substance, much resembling, in its disagreeable and suffocating smell, hard tallow. The slit or aperture of the tubes through which the arm communicates with the running piston and the carriages is about 1⅜ inch. We understand, if the experiment be successful, the company are to have the use of the patent gratis, for devoting the road to the trial, and are to purchase the whole apparatus and preparations at cost price; and if it does not succeed, all is to be cleared off within a given time. Supposing the experiment effects all that its advocates expect, we cannot see the use of so small an apparatus in such a place. If we remember right, the inclination of the road, about that part, is 120 feet a mile; therefore, the traction is more than three times that on a level, or above 24 lbs. to the ton. But a circular tube 9 inches diameter, fully exhausted, and exclusive of all friction, would only draw about 954 lbs., or, at 24 lbs. per ton, under 40 tons. The probability, however, is, that it will never in that length be half exhausted; so that the absolute load it would take would be under 20 tons, carriages, load and all, assuming a perfect absence of all friction in the machinery. We shall, however, be much surprised, if the useful effect is anything like this. Our opinion is, that the patentees have made the apparatus much too small for any useful purpose upon such a road, and also for the purpose of showing off the invention well, assuming it to be all that can be expected of it. A few days ago the works were suspended, in consequence of a dispute between the Messrs. Samuda and the contractors, about the point of delivery of the tubes —that is, whether it should be a few yards on the north, or a few on the south of the crossing of the Great Western line. Where so much is involved as here, this dispute is equally as ridiculous as that of the Lilliputians and their neighbours, about which end eggs ought to be broken.—*Railway Magazine.*

Galvanic Engraving.—It is not generally known that the method of producing fac-similies of engraved plates by means of voltaic electricity, as indicated by Mr. Brande, Mr. Faraday, and Professor Jacobi, has been frequently demonstrated with complete success by Bachhoffnor, of the Polytecnic Institution, in Regent-street, at which establishment many satisfactory specimens may be witnessed. The process is as follows:—The plate from which the duplicate is to be taken is first placed in a vessel properly adapted for the purpose, and is then covered with a solution of sulphate of copper, through which the galvanic stream is transmitted. This causes a decomposition, or, in other words, the constituents of the salt are removed from each other, the metallic copper resulting from the action being deposited in a series of thin laminæ upon the original plate. This deposited copper forms a second plate, which, on removal from the other, exhibits every line and mark traced by the graver or etching-tool upon it, with this difference, that what is bas-relief in one is alto-relief in the other, and the engraved lines of the original are raised lines in the duplicate. The sheet of copper thus produced becomes a normal plate or mould; from which, by a similar process, an *ad infinitum* number of plates may be taken, in every respect equal to the original, and capable, like it, of giving perfect printed impressions. The value of this practical discovery is great, inasmuch as it will supersede the necessity of expensive steel-plate engravings, by multiplying copies of those on copper plates at the cost of a few shillings and loss of a few days only. Impressions from medals, coins, and dies may be obtained in the same way, of which there are several specimens in the gallery of the Polytecnic Institution, as well as a very large duplicate copper plate of an elaborate engraving from one of Domenichino's pictures.

ON BLASTING LIMESTONE ROCK.

Some Account of Blasting the White Limestone in the County of Antrim, in Ireland. By William Bald, F.R.S.E., M.R.I.A., &c. *Read before the Institution of Civil Engineers.*

It becomes necessary to make a few short observations which may perhaps be interesting to the scientific engineer. Along the north coast of Ireland from the Bay of Belfast to Lough Foyle, the country consists of white limestone; columnar basalt, and some conglomerate sandstone; but the hill of Carey consists of mica slate; and is of the same formation as the Mull of Cantire, a part of the coast of Scotland lying opposite. The geologist can here easily trace the connecting link in the formation, which joins the two countries, although a channel 90 fathoms deep separates them. Numerous whin dykes intersect the strata along this part of the Irish shore, they run nearly parallel to each other in some cases, and are very remarkable in their structure.

The study of the peculiar qualities of the respective rocks and strata, and their position and inclination, will enable the engineer to work them in a more scientific manner. And in the construction of harbours, lighthouses, lines of navigation, drainage, roads, &c. &c., an intimate acquaintance with the component parts of the rocks will enable him to select those best suited to resist the action of time, whether they be placed under the dominion of the deep, exposed to the ravages of the pholas, or subject to perhaps the more wasting influence of the atmosphere; by such studies his skill will be alike visible in the selection of the best material for the repaving of even a common road, as it will be for that of the most splendid edifice destined to survive ages.

In constructing the Antrim coast road it became necessary to cut through extensive and high masses of white limestone; one of the sea cliffs in the Little Deer Park, near Glenarm Town, extended to a length of nearly one thousand yards, rising from twenty feet to about two hundred in height, washed at its base by a deep sea, and entirely exposed to the run of the ocean in the north channel.

Above the white limestone is situate the columnar basalt, but no part of the road was cut through this last mentioned rock. The white limestone in Antrim differs from the chalk in England, in being more indurated, while in other respects it is similar to it in the quantities of flint it contains. This rock is close and fine in its texture, but it is deeply fissured in many directions; the scull veins it exhibits are extremely curious.* The inclinations of the limestone strata on this part of the coast does not in general exceed 15° dipping into the land. Under the lime rock strata lies the brownish red coloured sandstone.

In blasting down those lofty cliffs of white limestone, the borings were always made into the toe of the rocks, and were so arranged that the line of least resistance should not be in the direction of the line of boring. Hundreds of tons of rock frequently rested on a base of a few superficial feet, which being blasted away, the cliff above tumbled down. The patent safety fuse was used, and which was attended with the most beneficial results, copper tubes for putting in the charges, and also copper needles.

During three years operations not a man was lost, although upwards of one hundred thousands tons of limestone were blasted down upon less than one mile of the road.

The following are the results of a few experiments made upon loose detached blocks of white limestone at Glenarm, Little Deer Park.

	Cubic feet in each block.	Quantity of powder used.	Cubic feet for each ounce of powder used.
Block No. 1.	165	12 oz.	13·78 ft.
2.	180	12 oz.	15·00
3.	540	38 oz.	14·21
4.	864	64 oz.	13·50

From the above experiments it took one ounce of gunpowder to rend asunder 14·12 cubic feet of the white limestone when in blocks. And from experiments made on the solid loose whinstone blocks, it took about one ounce of gunpowder to blast asunder 11·75 cubic feet.

Three experiments assigned the specific gravity of the white limestone at 2,747, 2,769, 2,763; and the whinstone or basalt at 3,200, being about 13 cubic feet of white limestone to the ton, and 11·20 cubic feet of the whinstone to the ton.

Table of the Working Proceedings.

	Depth of boring.	Quantity of powder.
An auger of 1¼ inch diameter.	15 inches deep.	6 inches.
Ditto 1½ ditto	26 ditto	8 ditto.
Ditto 1⅞ ditto	30 ditto	9 ditto.
Ditto 1⅞ ditto	36 ditto	12 ditto.
Ditto 1⅞ ditto	48 ditto	17 ditto.
Ditto 2 ditto	5 feet	20 ditto.
Ditto 2 ditto	6 feet	27 ditto.

The above table exhibits the diameter of the auger or jumper used, the depth sunk, and the number of inches of gunpowder* put in.

The force of the explosion of gunpowder is assumed to be as the cube of the length of the line of least resistance, thus if one ounce of gunpowder will open a distance of one foot of rock, the table would run thus:—

Line of least resistance.	Charge of powder exclusive of priming.
If 1 foot of rock requires	1 ounce.
2 feet would require	8 ditto.
3	27 ditto.
4	64 ditto.
5	125 ditto.
6	216 ditto.
7	343 ditto.
8	512 ditto.
9	729 ditto.
10	1000 ditto.

I am aware there is much difficulty in knowing exactly where the line of least resistance is, because the rock may be fissured, or some bed or opening may be near to the line bored, and this is the case where the rocks are stratified; but the hypogene rocks, such as granite and syenite, lying in large solid compact masses unstratified will be different, and these rules may be usefully applied. In blasting asunder loose detached blocks, a much greater quantity of material will be blown asunder by the same quantity of gunpowder than of rock lying in close connected beds.

It is always desirable to work the rock out by the dip of the inclination of the strata, or as the quarrymen call it, the going way of the rock.

In the white limestone quarries lying in the high ground north of the town of Belfast, where the limestone is quarried for building and agricultural purposes, and also for export; two men will quarry out at an average from eight to ten tons per day, the augurs or jumpers generally used are 1⅝ inches, and two inches diameter; and the induration of the white limestone may be estimated when two men will bore one foot deep in half an hour; they generally put in about three inches of powder for 15 inches deep, and 6 inches for about 2 feet deep; the expense for quarrying is about from fivepence to sixpence per ton. There are nearly 13 cubic foot of the white limestone to the ton, which is at the rate of nearly about one shilling per cubic yard. This white limestone is much esteemed in Glasgow and all the towns on the Clyde, where it sells for five shillings per ton—but the quarrying works near Belfast are carried on in a very limited manner, or rather on a very small scale.

Numerous experiments made by military engineers assign the force of the explosion of gunpowder to be as the cube of the length of the line of least resistance. Vauban and Belidor,† both of them excellent mathematicians, and also possessing great practical skill, ingenuity and experience, investigated this subject, doubtless more particularly with a view to the operations of war, than to those of the works of the civil engineer. The law of the explosive force of gunpowder remains the same in all the various forms it may be applied to matter, whether in blasting out of rock or earth, or the destruction of the masonry of fortifications by blowing them up, or laying in ruin bridges built over large and deep rivers to arrest the progress of hostile armies.

The total cubical contents of the four blocks of limestone given above, amounted to 1749 cubic feet, and the quantity of powder used 126 ounces, being at the rate of 1·94 ounces for each cubic yard blasted asunder. But if the rate per cubic yard be deduced from the quantity of powder expended on each block, then the following will be the results obtained from the four experiments.

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* The grey limestone with which the Light-house of Clare Island is built is much traversed by scull veins, and water enters them during severe rain storms.

* One pound of gunpowder occupies 30 cubic inches.

† Belidor, one of the most scientific of the French engineers, has given the following rule for finding the charge of a surcharged mine or globe of compression, "is to multiply the length of the line of least resistance in feet by 00, and the product will be the weight of the powder in pounds."

165 cubic feet was blasted asunder by 12 ounces of gunpowder, which is at the rate of 1·96 ounces of powder for each cubic yard.

180 cubic feet was blasted asunder by 12 ounces of gunpowder, which is at the rate of 1·80 ounces of powder for each cubic yard.

540 cubic feet was blasted asunder by 38 ounces of gunpowder, which is at the rate of 1·90 ounces of powder for each cubic yard.

864 cubic feet was blasted asunder by 64 ounces of gunpowder, which is at the rate of 2 ounces of powder for each cubic yard.

Therefore in the large loose limestone blocks about 2 ounces of gunpowder may be taken as the expenditure being necessary to blast out each cubic yard. The four blocks on which these experiments were made, were not at all cubical, although the one which contained 540 cubic feet was nearly so. From the above results I beg to submit some calculations regarding the force of the explosion of gunpowder, being as the cube of the length of the line of least resistance.

We are in possession of the quantity of gunpowder used in blasting the four blocks, and also of the solid feet contained in each of them. Extracting therefore the cubic root of the cubical contents of each block, we shall then have their masses all in cubical form as follows:

Cubic feet in each block.			Side of the cube.
$\sqrt[3]{165}$	-	-	5·484
$\sqrt[5]{180}$	-	-	5·646
$\sqrt[3]{540}$	-	-	8·143
$\sqrt[3]{864}$	-	-	9·524

Taking the length of the line of least resistance at each of these cubes to be equal to the distance from the centre to the nearest point on the surface, or equal to half the side of the cube, then the following will be the lengths in feet of the lines of least resistance.

In cube No. 1 — 2·742 feet.
No. 2 — 2·823
No. 3 — 4·071
No. 4 — 4·762.

The quantities of gunpowder consumed to blast asunder a line of least resistance, of

2·742 feet	was	12 ounces,	165	cubic feet blasted asunder.
2·823	-	12 ditto,	180	ditto.
4·071	-	38 ditto,	540	ditto.
4·762	-	64 ditto,	864	ditto.

If 165 cubic feet be blasted asunder by 12 ounces of gunpowder, the line of least resistance in that mass, if in cubical form, will be

$$\sqrt[3]{165} = 2{\cdot}742 \text{ feet.}$$

Then the line of least resistance for one foot in cubical form will be equal to 8 cubic feet. Then if 165 cubic feet with a line of resistance of 2·742 feet require 12 ounces of gunpowder to open it, then 8 cubic feet with a line of resistance of one foot will require 0·582 ounces of gunpowder to open it asunder.

The following are the quantities of gunpowder required to open one foot of least resistance through the white limestone, as determined by the blasting of the four blocks.

Cubic feet in each block - - -	165	180	540	864
Quantity of powder used to rend it asunder, in *ounces* - - - -	12	12	38	64
Cubic feet opened by the line of resistance of one foot - - - - - -	8	8	8	8
Quantity of powder required to open the line of least resistance of one foot, in *ounces* - - - - - -	0·582	0·533	0·563	0·593

Mean 0·568 oz.

Apply the rule of the cube of the length of the line of least resistance, and working with the element just obtained from the four experiments, to open asunder the line of least resistance of one foot.

No. 1—Then the scale of the length of the line of least resistance in No. 1, $2{\cdot}742^3$ feet multiplied by 0·582 ounces, the quantity of powder to open one foot will be $2{\cdot}742^3 = 20{\cdot}62 \times {\cdot}532 = 12$ ounces.

No. 2—For a line of least resistance of 2·823 feet will be 11·95 ounces, $2{\cdot}823^3 = 22{\cdot}42 \times {\cdot}533 = 11{\cdot}95$ ounces.

No. 3—For a line of least resistance of 4·071 feet, will be 37·97 ounces, $4{\cdot}071^3 = 67{\cdot}45 \times {\cdot}563 = 37{\cdot}97$ ounces.

No. 4—For a line of least resistance of 4·762 feet, will be 64 ounces, $4{\cdot}762^3 = 107{\cdot}983 \times {\cdot}593 = 64$ ounces.

It is therefore clear from these experiments made that the force of the explosion of gunpowder is as the cube of the length of the line of least resistance. Taking the mean quantity of gunpowder obtained from the four experiments to open asunder a line of resistance of one foot, and which is 0·568 ounces. The following will be the results calculated according to the cube of the length of the line of least resistance.

$$2{\cdot}742^3 = 20{\cdot}62 \times 0{\cdot}568 = 11{\cdot}71 \text{ oz.} = 165 \text{ cubic feet.}$$
$$2{\cdot}823^3 = 22{\cdot}42 \times 0{\cdot}568 = 12{\cdot}73 \text{ oz.} = 180$$
$$4{\cdot}071^3 = 67{\cdot}45 \times 0{\cdot}568 = 38{\cdot}31 \text{ oz.} = 540$$
$$4{\cdot}762^3 = 107{\cdot}983 \times 0{\cdot}568 = 61{\cdot}33 \text{ oz.} = 864.$$

In having described the mode of blasting the white limestone on the Antrim coast road in the north of Ireland. It may be useful as well as interesting to the engineer to describe its qualities, and to what extent it may be employed in the construction of works.

In treating of the nature of any kind of material to be employed in building, the first consideration is its character, to resist decomposition whether placed in the open air exposed to the full action of the atmosphere, or buried in the earth, or entombed in the deep. Its induration and compactness of structure, the absence of figures, the mass it can be had in, and the facility of working or tooling it into form.

The white limestone on the Antrim coast road lies in beds dipping slightly to the plane; it is generally quite white, but sometimes it is of a yellowish tint; it is traversed by very small veins of calcareous spar, but the most remarkable feature is the quantity of flints it contains, they are dry, grey and black; the thickness of the beds of the white limestone is very singular, being sometimes more than 30 feet.

This white limestone is not good for building, because it moulders by exposure to the atmosphere, it is not therefore generally used in any public building, although it might be used in filling up the interior parts of walls: it is inferior for road metal, being tender and wearing quickly; it can be procured in large masses, when reduced to pieces containing six, twelve and eighteen cubical inches, it breaks into irregular fragments with sharp edges.

The white limestone when placed under the sea is particularly subject to the ravages of the pholas, and is therefore unsuitable to be employed in the construction of marine works, such as harbours or breakwaters, &c., it is however a valuable material for making lime for building, and for agricultural purposes. In our quarrying operations we rarely found in it shell remains.

In quarrying it out in large masses, the blocks sometimes had what the workman call a lean and a full bed; the lean bed being less than an angle of 90°, and the full bed more than 90°. The white limestone can be split with plug and feather, or pooled by wedges; if the stratification be in thin beds, it opens across with a very rugged and irregular face, but if very solid and compact, and the beds of great thickness, it will open more evenly and equal in the face. It dresses readily with the hammer, and can be wrought and hewn into any form. I am however of opinion that the white limestone of the county of Antrim should not be used in constructing any work requiring durability, because it is a rock liable to decomposition when exposed to the atmosphere.

I have already, in the paper on blasting the white limestone, alluded to the small fissures which traverse that rock, and which also traverse the blue and grey limestone of Ireland, and which the stone-cutters call scull veins doublers, on account of their exact resemblance to the sutures in the human scull.

In concluding, I beg to mention that there are several species of the Pholas. Lamarh in his natural history, mentions the Pholade Dactyle or Pholas Dactylus, as being very prevalent on the coast of France, and also inhabiting the shores of the British seas. I have given a sketch of the Phoylas Dactylus, and I beg to present to the Institution a very beautiful specimen of this kind, from which the sketch has been made, and which specimen I have accidentally obtained in London. There is another species called the Pholade Scrabrelle, or Pholas Candida, which inhabits the European seas, and a very small kind called by the French Saxicave Ridée, Saxicava Rugosa. It is quite foreign to the object of this paper to enter into any thing like giving an account of all the various kinds of Pholas, or their habits; it is quite sufficient to the engineer to know that every description of calcareous rock, when placed under the sea, is subject to be perforated by those bivalves; indeed every rock upon which acids act are subject to be destroyed by them, and it consequently has been conjectured that they possess the power of producing an acid that decomposes the rock containing calcareous matter; on the other hand some maintain this is not the case, because the acid would also decompose the shell which covers them. Mr. Lonsdale, of the Geological Society, mentioned to me that some marine works constructed at Plymouth were much injured by the ravages of the Pholas. Beds of calcareous rock of several feet in thickness, in the Frith of Forth have been entirely destroyed by the Pholas.

It will be seen that the shell of the Pholas Dactylus, presented to the Institution, is very tender and delicate; from the extreme fragile nature of the shell it would not be supposed capable of destroying indurated